Panasonic

KW1M
Eco-POWER METER
User's Manual

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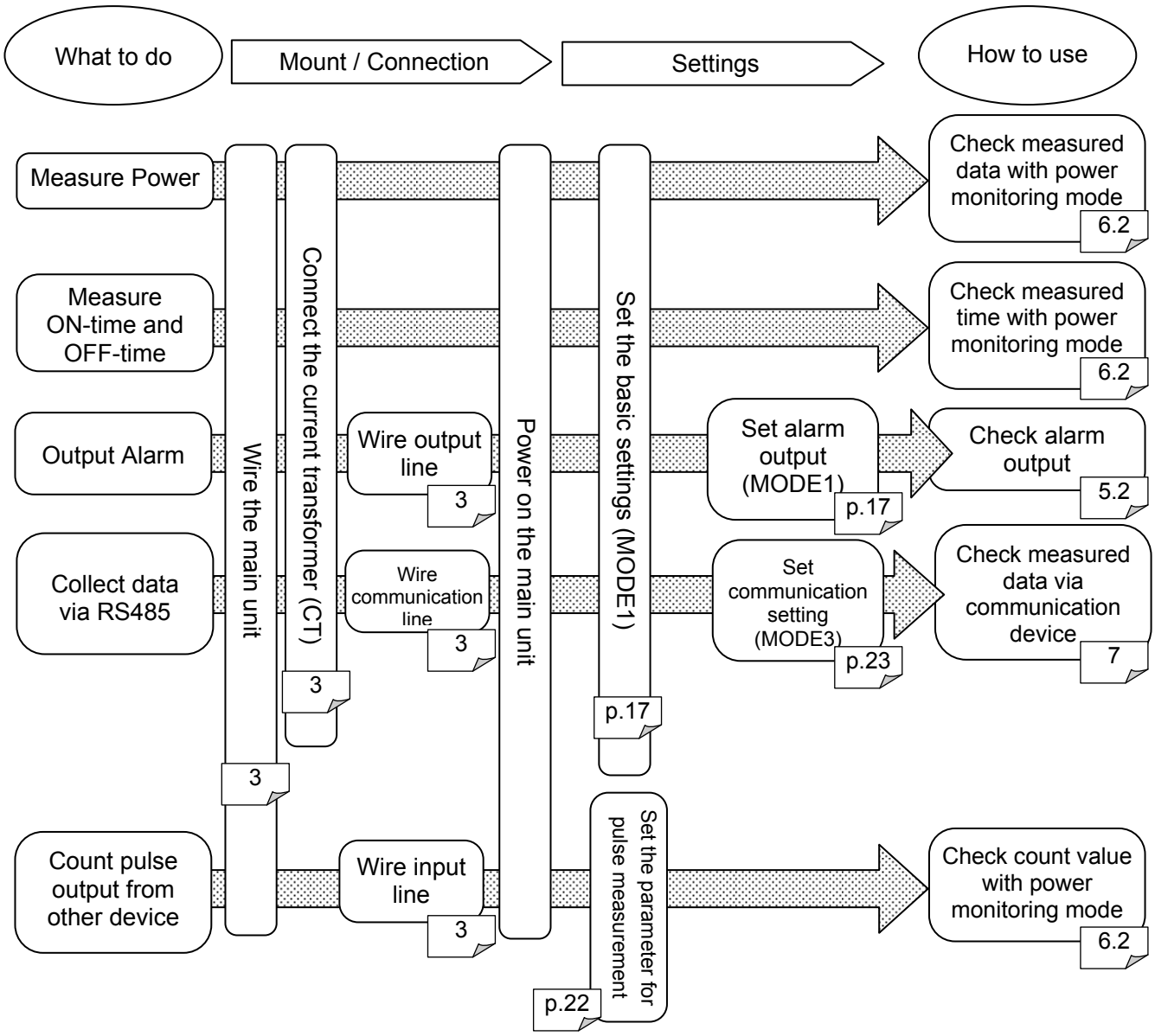
Basic setting to measure by Eco-POWER METER

When wiring the main unit and the current transformer (CT) and setting the basic setting after power on, you can measure the power
The basic setting of MODE1 is necessary to measure.
In order to use the other functions, the settings of the each parameter are necessary.



*Only AKW1111 (400VAC applicable type)

Cautions for Your Safety

Read the manual carefully before installing, running and maintenance for proper operation.

Before using, master the knowledge of the equipment, safety information and all of other notes.

This manual uses two safety flags to indicate different levels of danger.

⚠ **WARNING**	A handling error could cause serious physical injury to an operator and in the worst case could even be fatal.

- Always take precautions to ensure the overall safety of your system, so that the whole system remains safe in the event of failure of this product or other external factor.
- Do not use this product in areas with inflammable gas. It could lead to an explosion.
- Exposing this product to excessive heat or open flames could cause damage to the lithium battery or other electronic parts.

⚠ **CAUTION**	A handling error could cause serious physical injury to an operator or damage to the equipment.

- To prevent abnormal exothermic heat or smoke generation, use this product at the values less than the maximum of the characteristics and performance that are assured in these specifications.
- Do not dismantle or remodel the product. It could lead to abnormal exothermic heat or smoke generation.
- Do not touch the terminal while turning on electricity. It could lead to an electric shock.
- Use the external devices to function the emergency stop and interlock circuit.
- Connect the wires or connectors securely. The loose connection might cause abnormal exothermic heat or smoke generation.
- Do not allow foreign matters such as liquid, flammable materials, metals to go into the inside of the product. It might cause exothermic heat or smoke generation.
- Do not undertake construction (such as connection and disconnection) while the power supply is on.
- Do not use at secondary side circuit of inverter. It might cause exothermic heat or damage.

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Introduction

Thank you very much indeed for purchasing “KW1M Eco-POWER METER”.
In this manual, we explain the usage of “KW1M-H Eco-POWER METER” in detail.
Please use it correctly after understanding the content enough.

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Cautions before using

■ Installation environment

◇Do not use the Unit in the following environments.

- ・Where the unit will be exposed to direct sunlight and where the ambient temperature is outside the range of -10 to 50 °C.
- ・Where the ambient humidity is outside the range of 30 to 85 % RH (at 20℃, non-condensing) and where condensation might occur by sudden temperature changes
- ・Where inflammable or corrosive gas might be produced
- ・Where the unit will be exposed to excessive airborne dust or metal particles
- ・Where the unit will be exposed to water, oil or chemicals
- ・Where organic solvents such as benzene, paint thinner, alcohol, or strong alkaline solutions such as ammonia or caustic soda might adhere to the product
- ・Where direct vibration or shock might be transmitted to the product, and where water might wet the product
- ・Where the place near high-voltage cable, high-voltage device, power line, power device.
- ・Where the place near a machinery with transmission function such as amateur radio.
- ・Where the place near a machinery which occurs the big switching serge

◇Please use the Unit according to the specifications described in this manual. Otherwise, it may malfunction or cause fire and an electric shock.

- ・Connect to the power supply in compliance with the rating.
- ・Refer to the wiring diagram to ensure proper wiring for the power supply, input and output.
- ・Do not perform wiring or installation with a live line. It may also lead to circuit burnout or fire by way of the secondary CT side opening.

■ Installation

- ・Installation and wiring must be performed by expert personnel for electrical work or electric piping.
- ・The power supply terminal and voltage input terminal of the main unit is common. Therefore if additional noise effects the power supply line, incorrect measurements may result.
- ・Eco-POWER METER is designed to be used in a control panel.
- ・Do not add an excess power to the display. It might break the inner liquid crystal.

■ As to measurement

- ・If there is some distortion by harmonic or waveform, it may not measure correctly. Please check with the actual system before adopts it.
- ・This can't measure the power that flows reverse such as a regenerative electric power. If you measure a reverse power, it shows "0.00kW" and it doesn't count.
- ・It might not measure an instantaneous current such as an inrush current or an welding machine.
- ・When measuring the below loads, it might not satisfy with the accuracy guarantee.
  Out of rating current, Load with low power factor,
  Load with winding current, Load with ferromagnetic field
- ・Power factor operation is a method assuming balanced load. The error might be big when it measures unbalanced load.

■ Static electricity

- ・Discharge static electricity touching the grounded metal etc. when you touch the unit.
- ・Excessive static electricity might be generated especially in a dry place.

■ Cleaning

- ・Wipe dirt of the main unit with soft cloth etc. When thinner is used, the unit might deform or be discolored.

■ Power supply

- Connect a breaker to the voltage input part for safety reasons and to protect the device.
  The breaker that connects to the voltage input part must arrange at the position easily reached, and display shows it is the breaker of the equipment.
- Do not turn on the power supply or input until all wiring is completed.

■ Before power on

Please note the following points when turning on power at the first time.

- Confirm there are neither wiring rubbish nor especially an electrical conduction when installed.
- Confirm neither the power supply wiring, the I/O wiring nor the power-supply voltage are wrong.
- Tighten the installation screw and the terminal screw surely.
- Use an electric wire applicable to the rated current.

Chapter 1 Unit's Features and Structure

KW1M Eco-POWER METER is the suitable size wattmeter for installing in a control board.
It measures electrical power, voltage, current and so on using AC voltage and AC current input.
It also works ad an hour meter, which is measured power-on or power-off time.

1.1 Unit's Name and Model Numbers

1.1.1 Main unit

Product name	Measured voltage input	Model No.
KW1M Eco-POWER METER (400VAC applicable type)	・400VAC ・100/200VAC	AKW1111
KW1M Eco-POWER METER	・100/200VAC	AKW1110

Phase and Wire system	・Single-phase two-wire ・Single-phase three-wire ・Three-phase three-wire ・Three-phase four-wire *1
Power supply	100-240V AC 50/60Hz
Measured current input	50A / 100A / 250A / 400A / 600A
Current transformer	Dedicated CT type
Terminal type	Screw Terminal (M3 + / - screw, M3.5 + / - screw) *2

*1 only for AKW1111 (400VAC applicable type)
*2 M3.5 screws are only for AKW1111 power supply terminal and voltage input terminal (P0, P1, P2, and P3).

1.1.2 Option

Dedicated Current Transformer (CT) Clamp-on type

Product name	Rated primary current	Model No
Dedicated current transformer for 5A/50A	5A / 50A	AKW4801C
Dedicated current transformer for 100A	100A	AKW4802C
Dedicated current transformer for 250A	250A	AKW4803C
Dedicated current transformer for 400A	400A	AKW4804C
Dedicated current transformer for 600A	600A	AKW4808C

Dedicated Current Transformer (CT) Through type

Product name	Rated primary current	Model No
Dedicated current transformer for 50A/100A	50A / 100A	AKW4506C
Dedicated current transformer for 250A/400A	250A / 400A	AKW4507C
Dedicated current transformer for 600A	600A	AKW4508C

Others

Product name	Model No
Mounting rail	AT8-DLA1
Fastening plate	ATA4806
Mounting frame	AKW1822

1.2 Measurement items: AKW1111 (400VAC applicable type)

Item		Unit	Data range
Integral electric power (Active)		kWh/ MWh	0.00 to 9999.99MWh (9-digit display) 0.00 to 9999999.99kWh
Instantaneous electric power (Active)		kW	0.00 to 9999.99
Current	R-current	A	0.0 to 6000.0
	S-current		
	T-current		
Voltage	R(RS)-voltage	V	0.0 to 9999.9
	S(RT)-voltage		
	T(TS)-voltage		
Electricity charge *			0.00 to 999999
Conversion value	Carbon dioxide	kg-CO_2	0.00 to 999999
Power Factor			0.00 to 1.00 (Identify leading phase(－) and lagging phase) (Within the range of phase angle θ=-90 to 90 degree)
Frequency	Hz		47.5 to 63.0
Hour meter	ON-time	hour	0.0 to 99999.9
	OFF-time		
Pulse counter			0 to 999999

*Eco-POWER METER is designed chiefly to manage saving energy.
It is neither intended nor can it be legally used for billing.

1.3 Measurement items: AKW1110

Item		Unit	Data range
Integral electric power (Active)		kWh/MWh	0.00 to 9999.99MWh (9-digit display) 0.00 to 9999999.99kWh
Instantaneous electric power (Active)		kW	0.00 to 9999.99
Current	R-current	A	0.0 to 6000.0
	T-current		
Voltage	R(RS)-voltage	V	0.0 to 9999.9
	T(TS)-voltage		
Electricity charge *			0.00 to 999999
Conversion value	Carbon dioxide	kg-CO_2	0.00 to 999999
Hour meter	ON-time	hour	0.0 to 99999.9
	OFF-time		

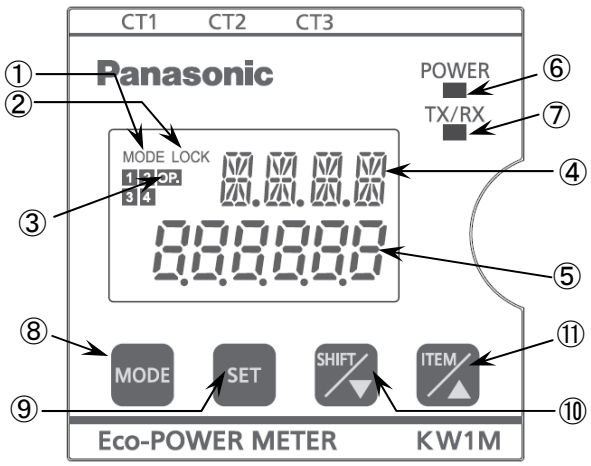
*Eco-POWER METER is designed chiefly to manage saving energy.
It is neither intended nor can it be legally used for billing.

Chapter 2 Parts Name and Working

2.1 Parts Names

①MODE indicator	Lighting when mode setting
②LOCK indicator	Lighting while in lock mode
③OP. output indicator	Lighting when pulse output
④Mode display	Display mode in setting and measurement item with 16-seg
⑤Display each value	With 7-seg ・Display each measured value ・Display each setting value
⑥POWER indicator	Lighting while power on
⑦TX/RX indicator	Blinking while communication
⑧<MODE> key	
⑨<SET> key	
⑩<SHIFT / ▽ > key	
⑪<ITEM / △ >key	

<AKW1111>



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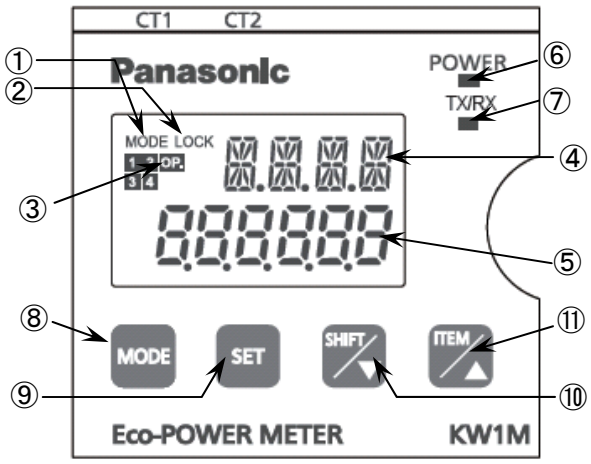


2.2 Key's Functions

Key	Functions
<MODE>	・Use to shift setting mode
<SET>	・Use to set each value entered ・Reset stand-by alarm while output the alarm (only available while output the stand-by alarm) *only for AKW1111(400VAC applicable type)
<SET> (continuous press 3-sec)	・All keys locked ・Release lock mode while in lock mode
<SHIFT / ▽>	・To select measured value display (While monitoring) ・To select setting value (While setting mode)
<ITEM / △>	・To select measured value display (While monitoring) ・To select setting value (While setting mode)
<SET>+<MODE>	・To reset the measured value

Chapter 3 Wiring

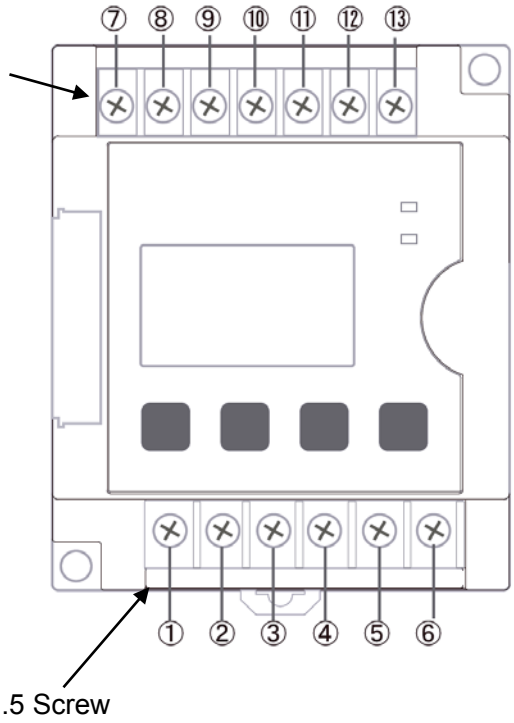
3.1 AKW1111 (400V AC applicable type)

Be sure to wire correctly according to the terminal arrangement and wiring diagrams.
After completing wiring, be sure to attach the terminal cover for safety reasons.

3.1.1 Terminal arrangement

M3 Screw

No.	Function		Screw
①	L	Power supply	M3.5 + / - Screw
②	N		
③	P1	Measured voltage input	
④	P0		
⑤	P2		
⑥	P3		
⑦	＋	RS485	M3 + / - Screw
⑧	－		
⑨	E		
⑩	＋	Pulse output	
⑪	－		
⑫	＋	Pulse input	
⑬	－		



⚠ **The input voltage to each terminal is as follows.**

Terminal	Phase and wire	Terminal	Input voltage	
Operating power supply	1P2W	①－②	100-240VAC (100-240V～)	(Line voltage)
Measured voltage input	1P2W	③－④	0-440VAC (0-440V～)	(Line voltage)
	1P3W	③－④－⑤	0-220VAC (0-220V～:3W)	(Phase voltage)
	3P3W	③－④－⑤	0-440VAC (0-440V 3～)	(Line voltage)
	3P4W	③－④－⑤－⑥	0-254VAC (0-254V 3N～)	(Phase voltage)

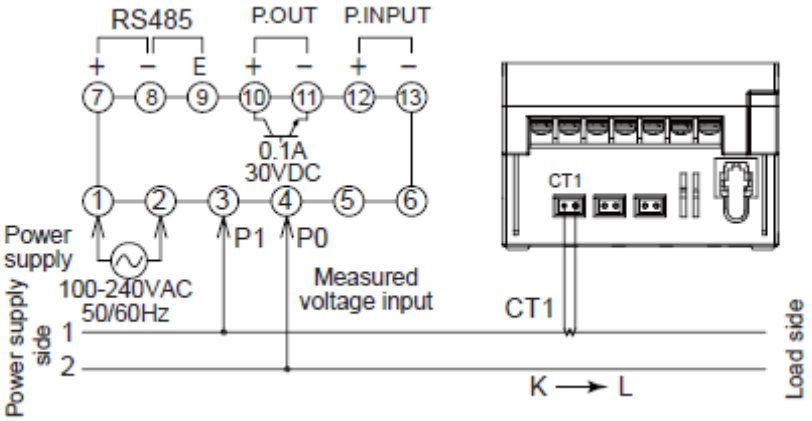
3.1.2 Wiring Diagrams

Please connect a breaker (3 to 15A) to the voltage input part for safety reasons and to protect the device. Grounding the secondary side of VT (Voltage transformer) and CT (Current transformer) is not necessary with low-voltage circuit.

◆When measuring a load with rated input voltage (100-200V system/ 400V system)

Single-phase two-wire system

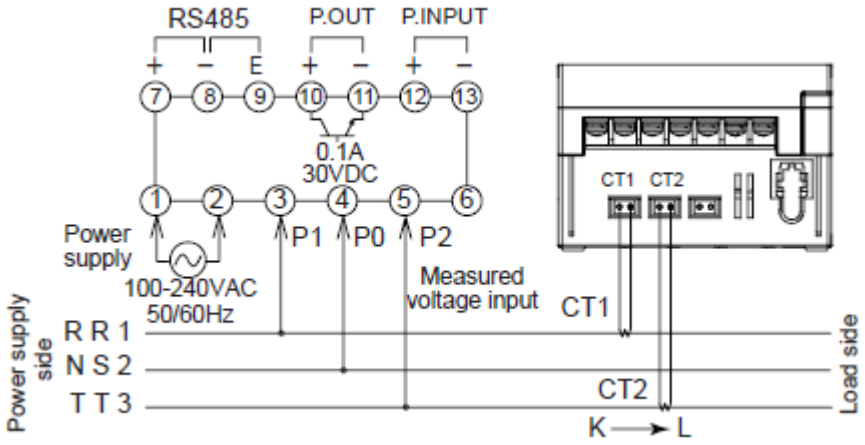
＊One current transformer (CT) is required.
Do not wire ⑤ ⑥terminals. They are connected internal.



Single-phase three-wire / Three-phase three-wire system

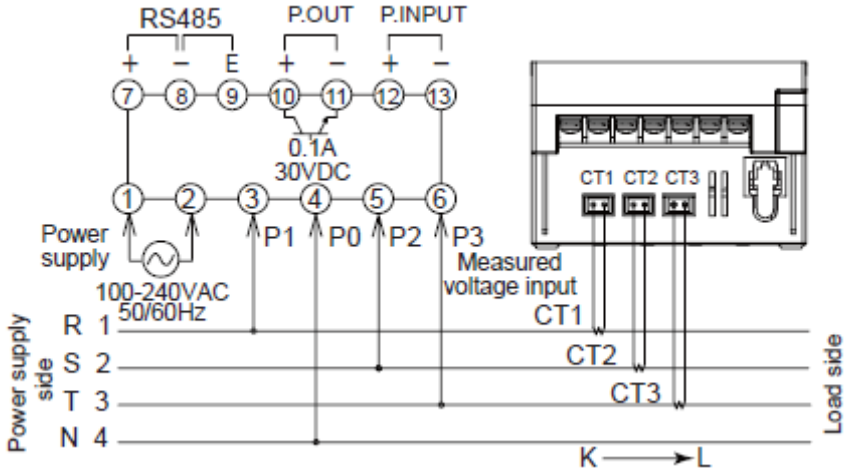
＊Two current transformers are required.

Do not wire ⑥ terminals. They are connected internal.



Three-phase four-wire system

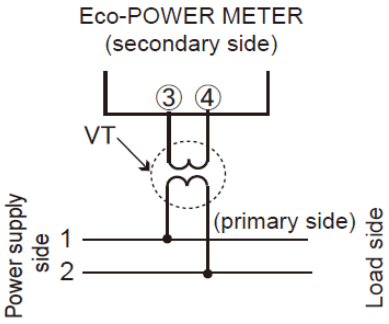
＊Three current transformers are required.



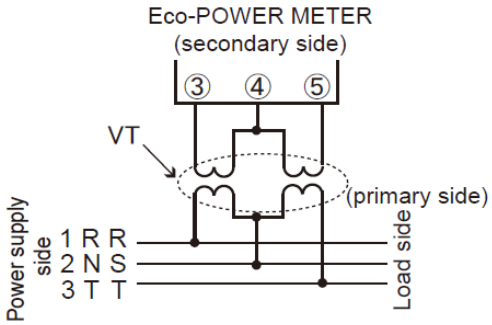
◆When measuring a load with exceed input voltage

Voltage transformer (VT) is needed when you measure a load with over rated input voltage (440V).
Use VT, those secondary rating is 110V.
Grounding the secondary side of VT and CT is not necessary with low-voltage circuit.

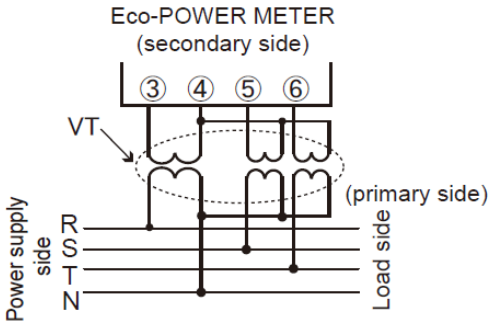
Single-phase two-wire system



Single-phase, three-wire system
Three-phase, three-wire system



Three-phase, four-wire system

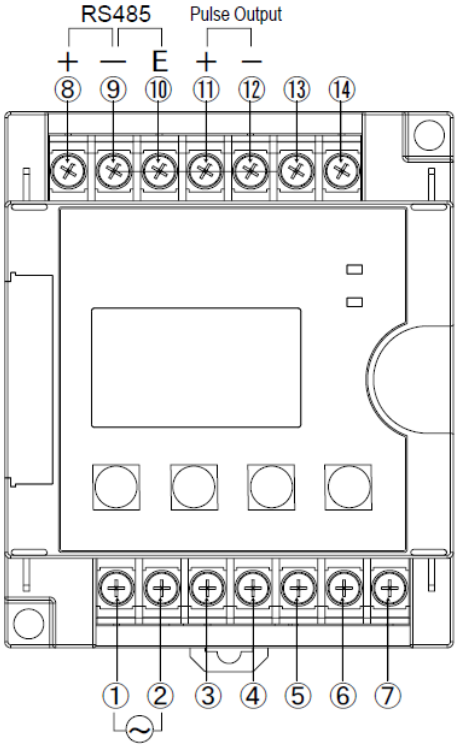


3.2 AKW1110

Be sure to wire correctly according to the terminal arrangement and wiring diagrams.
After completing wiring, be sure to attach the terminal cover for safety reasons.

3.2.1 Terminal arrangement

No.	Function		Screw
①	L	Power supply	M3 + / - Screw
②	N		
③	N.C.		
④	P1	Measured voltage input	
⑤	P0		
⑥	P2		
⑦ *1	N.C.		
⑧	＋	RS485	M3 + / - Screw
⑨	－		
⑩	E		
⑪	＋	Pulse output	
⑫	－		
⑬ *1	N.C.		
⑭ *1			



*1) ⑦, ⑬ and ⑭ terminals are connected internal to analog input terminal.

⚠ **The input voltage to each terminal is as follows.**

Terminal	Phase and wire	Terminal	Input voltage	
Operating power supply	1P2W	①－②	100-240VAC (100 – 240V～)	(Line voltage)
Measured voltage input	1P2W	④－⑤	0-220VAC (0-220V～)	(Line voltage)
	1P3W	④－⑤－⑥	0-110VAC (0-110V～:3W)	(Phase voltage)
	3P3W	④－⑤－⑥	0-220VAC (0-220V 3～)	(Line voltage)

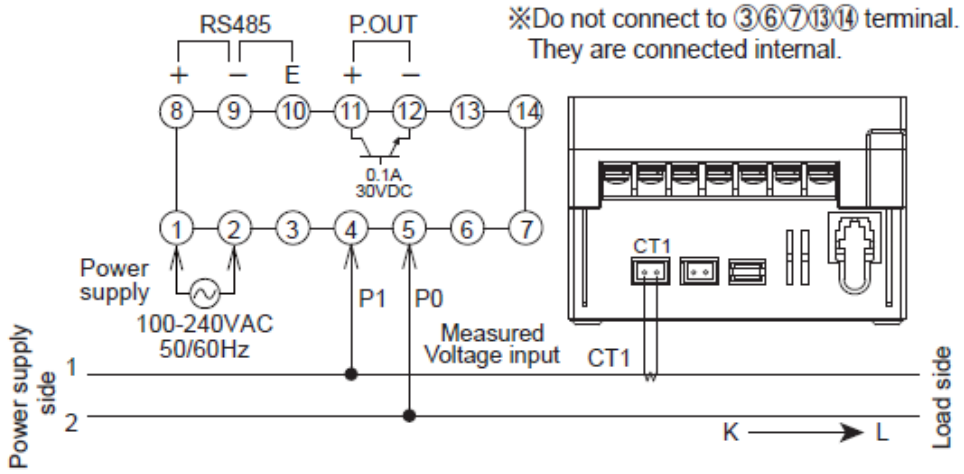
3.2.2 Wiring Diagrams

Please connect a breaker (3 to 15A) to the voltage input part for safety reasons and to protect the device. Grounding the secondary side of VT (Voltage transformer) and CT (Current transformer) is not necessary with low-voltage circuit.

◆When measuring a load with rated input voltage (100-200V system)

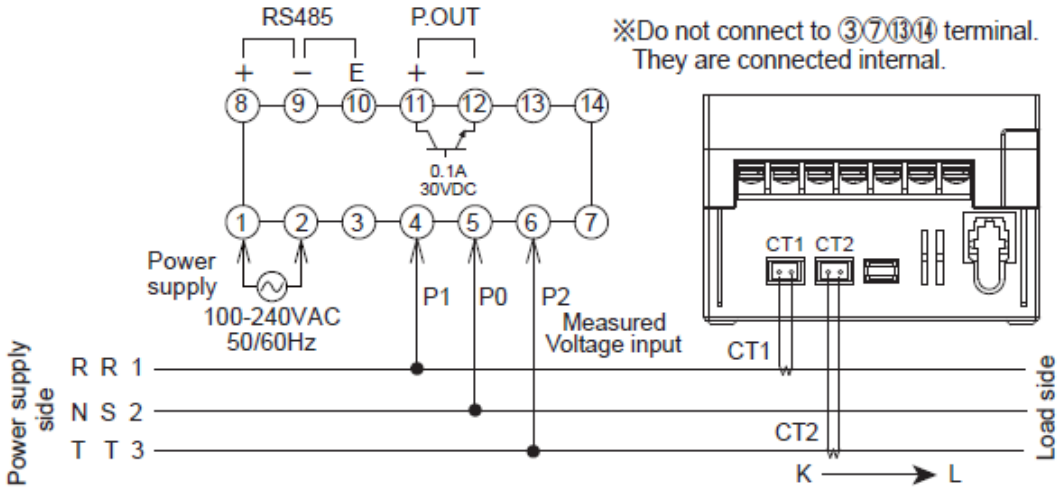
Single-phase two-wire system

＊One current transformer (CT) is required.



Single-phase three-wire / Three-phase three-wire system

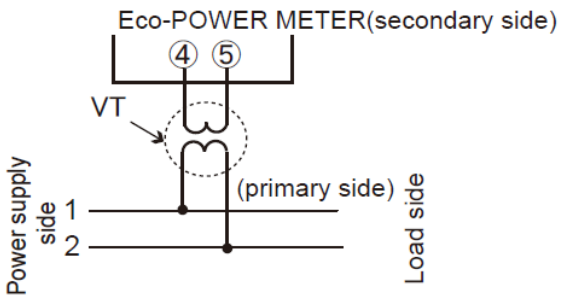
＊Two current transformers are required.



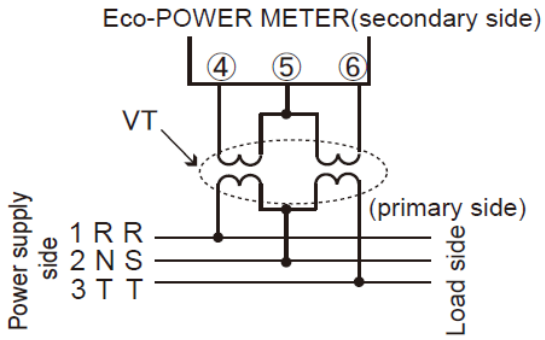
◆When measuring a load with exceed input voltage

Voltage transformer (VT) is needed when you measure a load with over rated input voltage (440V).
Use VT, those secondary rating is 110V.
Grounding the secondary side of VT and CT is not necessary with low-voltage circuit.

Single-phase two-wire system



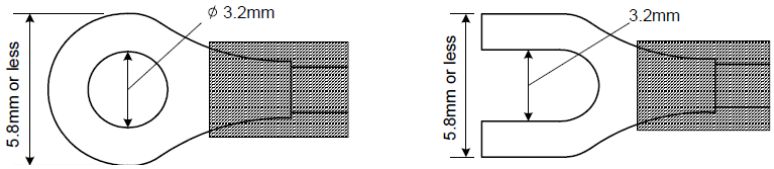
Single-phase, three-wire system
Three-phase, three-wire system



3.3 Caution for Wiring

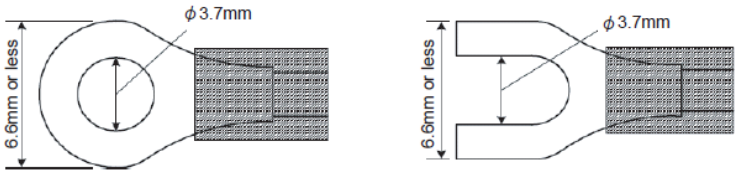
1) Terminal fastening torque should be 0.5 to 0.6N·m for M3 screw and should be 1.0N·m for M3.5 screw. In case of using a crimping terminal, use it with insulating sleeve applicable to M3 screw or M3.5 screw.
2) This has no built-in power switch, circuit breaker for power supply part. To protect the device, it is necessary to install power switch and circuit breaker in the power supply circuit.
   And this has no built-in power switch, circuit breaker or fuse for measured voltage input parts.
   Therefore it is necessary to install them in the circuit near this unit.
3) We recommend a wire with the cross section of 0.75 to 1.25mm^2 for power supply line and measured voltage input line.
4) Use flame-resistant cable for each wiring.

<M3 screw>

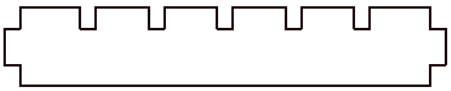


Terminal cover shape

<M3.5 screw>　*only AKW1111



Terminal cover shape



3.4 How to attach the Current Transformer (CT)

・One current transformer (CT) is needed to measure 1P2W system. Two CTs are needed to measure a 1P3W/3P3W system. Three CTs are needed to measure a 3P4W system. Using all CT should be the same.

・Check beforehand that the thickness of the electric wire is smaller than the through-hole of the CT.

・When connecting CT, connect the secondary side to the terminal of the main unit first, and after that wire the primary side to a load electric wire.
Incorrect order might cause an electric shock or break CT.

・The CT has polarity. Wire correctly according to the K and L marks.
Wrong direction can't measure correctly.

・When closing clamp-on type CT, check that there is no foreign materials on the divided face. And make sure it is closed securely once the wire is in place; **if not the measurement value will be not accurate.**

・When CT's cable is extended, it is possible to extend up to about 10m with the cable of AWG#22 or more cross section under the environment without noise at all. Please use the thick cable as much as possible. *Please check beforehand with the actual system in case of extending the cable.

・If there is some distortion by harmonic or waveform, it may not measure correctly. Please check with the actual system before adopting it.

・Separate the wiring (strong electric part) of the measured voltage input terminal (operating power supply terminal) from the CT cable. It may not satisfy the accuracy due to noise.

◇To connect CT with secondary side current 5A

How to connect for measuring by combination with CT (secondary side current 5A)

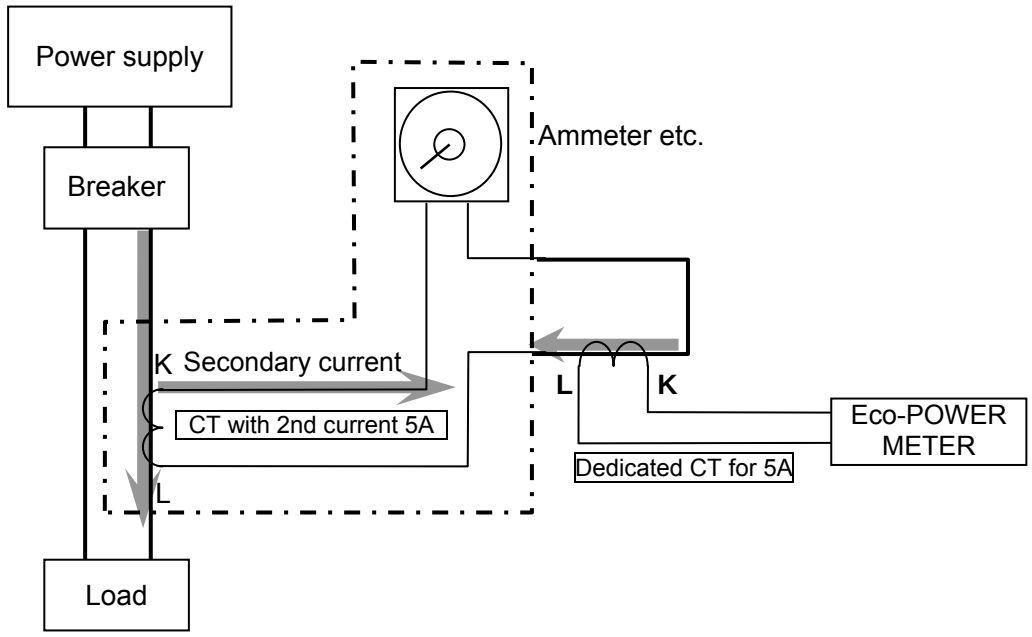
(1) Select 5A at CT type setting mode (CT-T).

(2) Set the primary current of measured CT (secondary side current 5A) at primary side current of CT setting mode (CT-1).
< ex > If the measured CT is 400A/5A, set to"400".

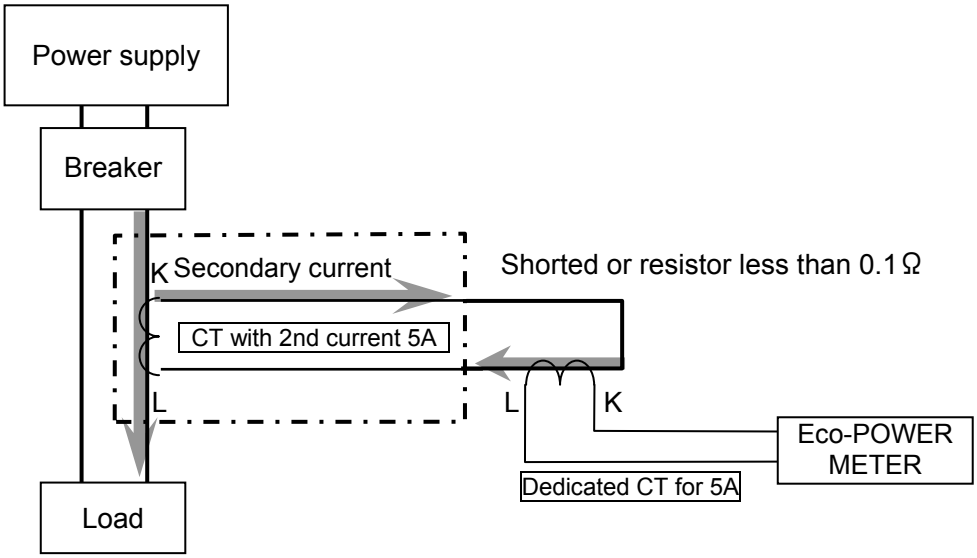
(3) Clamp the dedicated CT for 5A, which is connected to the main unit first, to secondary side of the CT (secondary side current 5A). CT direction (K→L) should be set for the commercial CT direction.

＊Set the CT (secondary side current 5A) and the dedicated CT for 5A approximately 1m apart. If the two CTs are set too close each other, it may not measure accurately due to magnetic field interference.

(Connection example)
With Ammeter etc.



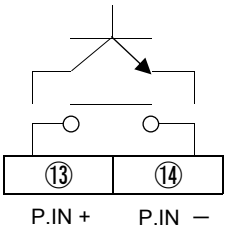
Without Ammeter



3.5 For input connection

・Contact input

Use highly reliable metal plated contacts. Since the contact's bounce time leads directly to error in the count value, use contacts with as short a bounce time as possible. In general, select 30Hz for max. counting speed.



・Non-contact input (Transistor input)

Connect with an open collector. Use the transistor with the following specifications. V_{CEO}=20V min. I_C=20mA min. I_{CBO}=6μA max

Use transistors with a residual voltage of less than 1.5V when the transistor is ON.

＊Short-circuit impedance should be less than 1kΩ.
(When the impedance is 0Ω, drain current is approx. 7mA.)
Open-circuit impedance should be more than 100kΩ.

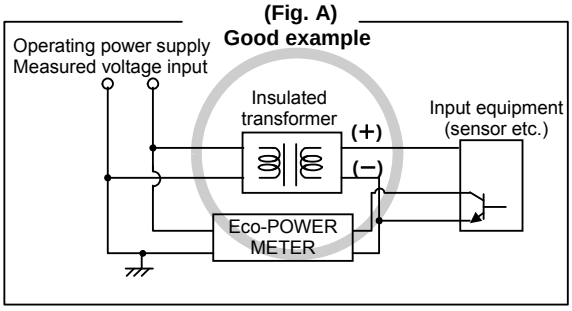
・Input wiring

Please wire up to 10m by using a shielded wire or a metallic electric wire tube individually.
If it is long, it may not work correctly due to floating capacitance of wire.

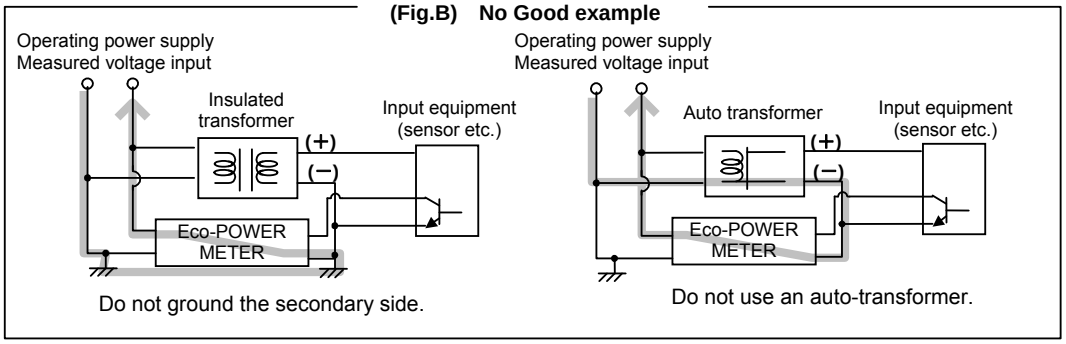
(Note)

Operating power supply input part and measured voltage input are not insulated to pulse input parts. So the input equipment must have the power supply transformer in which the secondary side is not grounded with the primary and secondary sides insulated, in order to prevent interference of the power supply circuit when connecting the external input circuit. Be sure not to use an auto-transformer.

(Fig. A)
Good example

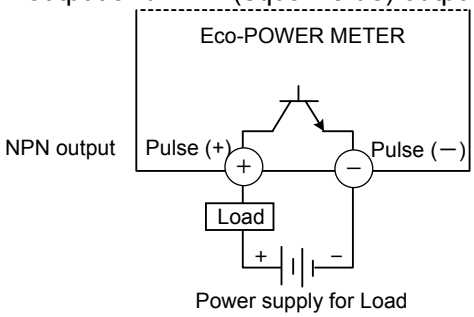


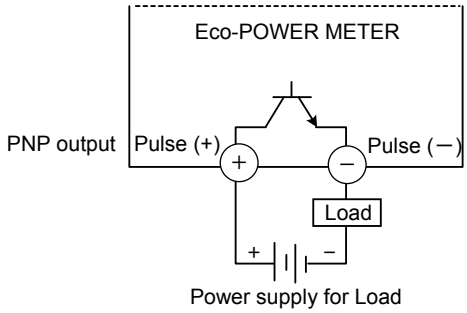
(Fig.B) No Good example



3.6 For Output connection

Since the transistor output is insulated from the internal circuit by a photo-coupler, it can be used both as a NPN output and PNP (equal value) output.





・Wire up to 100m for output connection.
If it is long, it may not work correctly due to floating capacitance of wire.

	Pulse(＋)	Pulse(－)
AKW1111	⑩	⑪
AKW1110	⑪	⑫

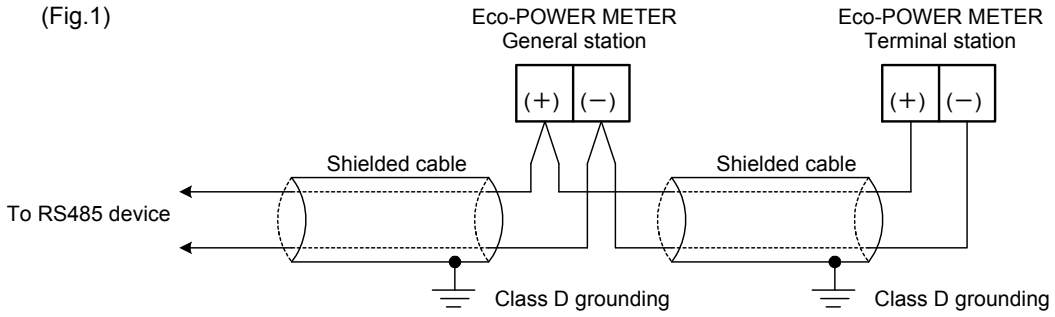
3.7 RS485 Communication

・When using shielded cable for the RS485 transmission line, ground one end.
Use a class D dedicated earth for grounding. Do not share a ground with other earth lines. (Fig.1)
・Be sure to connect with daisy chain the RS485 transmission line between each unit.
Do not use a splitter. (Fig.2)
・With a terminal station, RS485 (E) and RS485 (-) should be shorted.

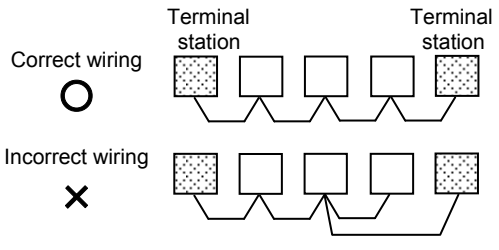
	RS485(E)	RS485(－)
AKW1111	⑨	⑧
AKW1110	⑩	⑨

*E terminal is not SG (signal ground) terminal. Do not ground shielded cable.

(Fig.1)



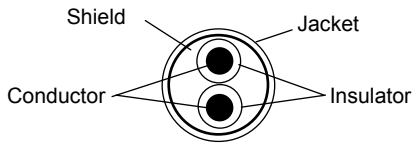
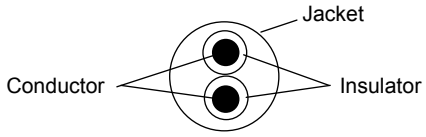
(Fig.2)



Recommended Cable

Use the transmission cables shown below for Eco-POWER METER RS485 communication system.

Cable	Conductor		Insulator		Cable diameter	Applicable cable
	Size	Resistance (at 20℃)	Material	Thickness		
Twisted-pair with shield	1.25 mm^2 (AWG16) or more	Max.16.8Ω/km	Polyethylene	Max. 0.5 mm	Approx. 8.5 mm	HITACHI KPEV-S 1.25 mm^2 × 1P Belden Inc. 9860
	0.5 mm^2 (AWG20) or more	Max.33.4Ω/km	Polyethylene	Max. 0.5 mm	Approx. 7.8 mm	HITACHI KPEV-S 0.5 mm^2 × 1P Belden Inc. 9207
VCTF	0.75 mm^2 (AWG18) or more	Max.25.1Ω/km	PVC	Max. 0.6 mm	Approx. 6.6 mm	VCTF 0.75 mm^2 × 2C (JIS)

Cable	Section
Twisted-pair with shield	
VCTF	

Notes
1) Use shielded type twist cables.
2) Use only one type of the transmission cables.
2) Do not mix different types of the cables.
3) Use twist pair cables under a bad noise environment.

3.8 Low Voltage Directive

When using in the application confirming to EN61010-1/IEC61010-1, make sure to satisfy the following conditions.

(1) Pulse output part secure only basic insulation. In order to secure reinforced (double) insulation demanded by EN 61010-1/ IEC61010-1, secure basic insulation or more with load side and reinforced (double) insulation with communication system side.
(2) Provide the voltage input part with an EN60947-1 or EN60947-3 compliant circuit breaker.
The breaker that connects to the voltage input part must arrange at the position easily reached, and display shows it is the breaker of the equipment.
(3) Use a wire with basic insulation or more for a wire cramped (or connected) CT.

【Environmental conditions】

- Overvoltage category Ⅱ, Pollution degree 2
- Indoor use
- An ambient temperature of –10 to 50℃
- An ambient non-condensing humidity of 35 to 85%RH (at 20℃)
- Altitude of 2000m or less

【Mount the product in a place with】

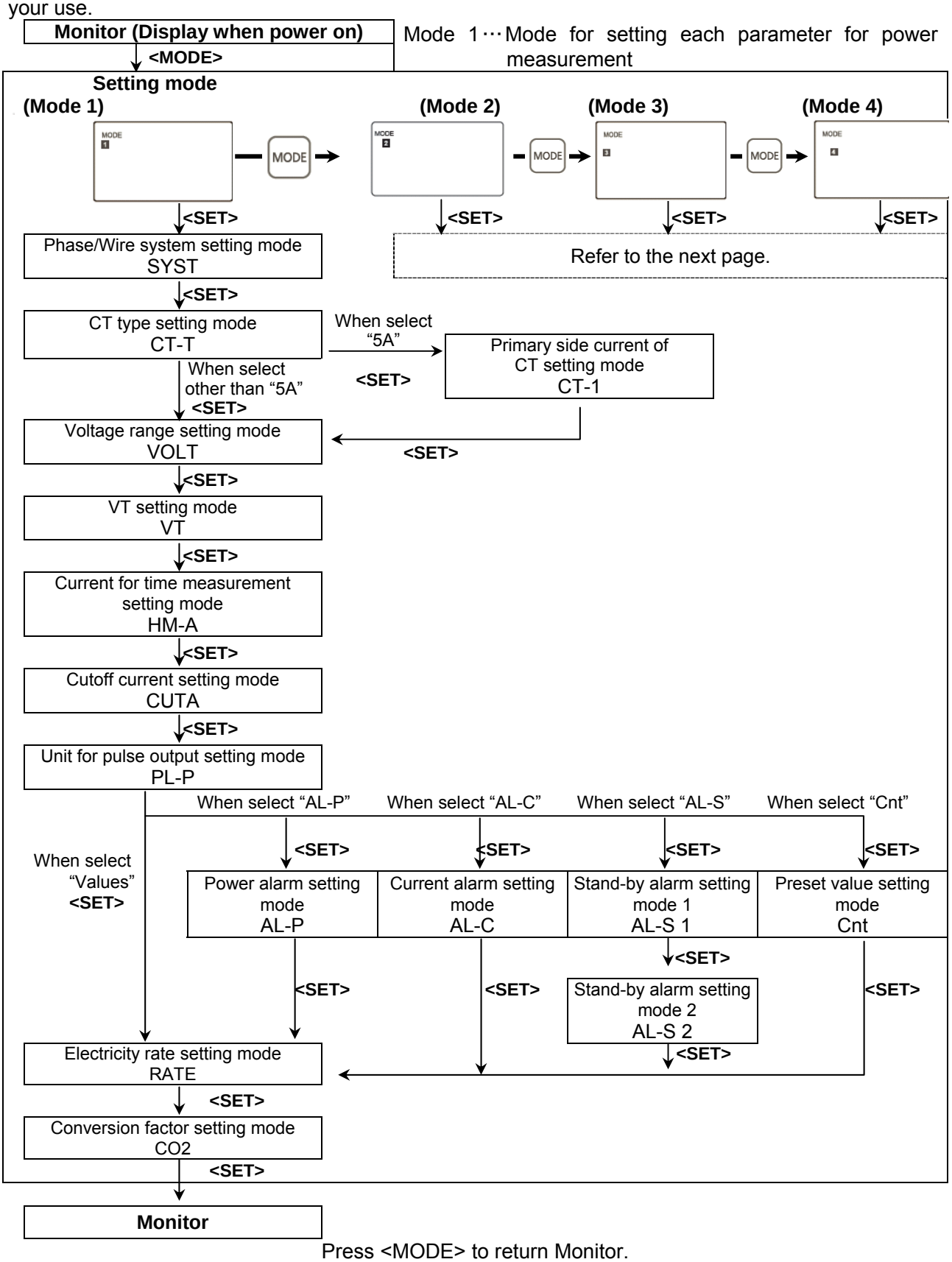
- A minimum of dust, and an absence of corrosive gases
- No flammable, explosive gasses
- Few mechanical vibrations or shocks
- No exposure to direct sunlight
- No large capacity electromagnetic switches or cables through which large current is flowing

Chapter 4 Setting

4.1 Operation procedure AKW1111 (400VAC applicable type)

【Basic setting to measure】

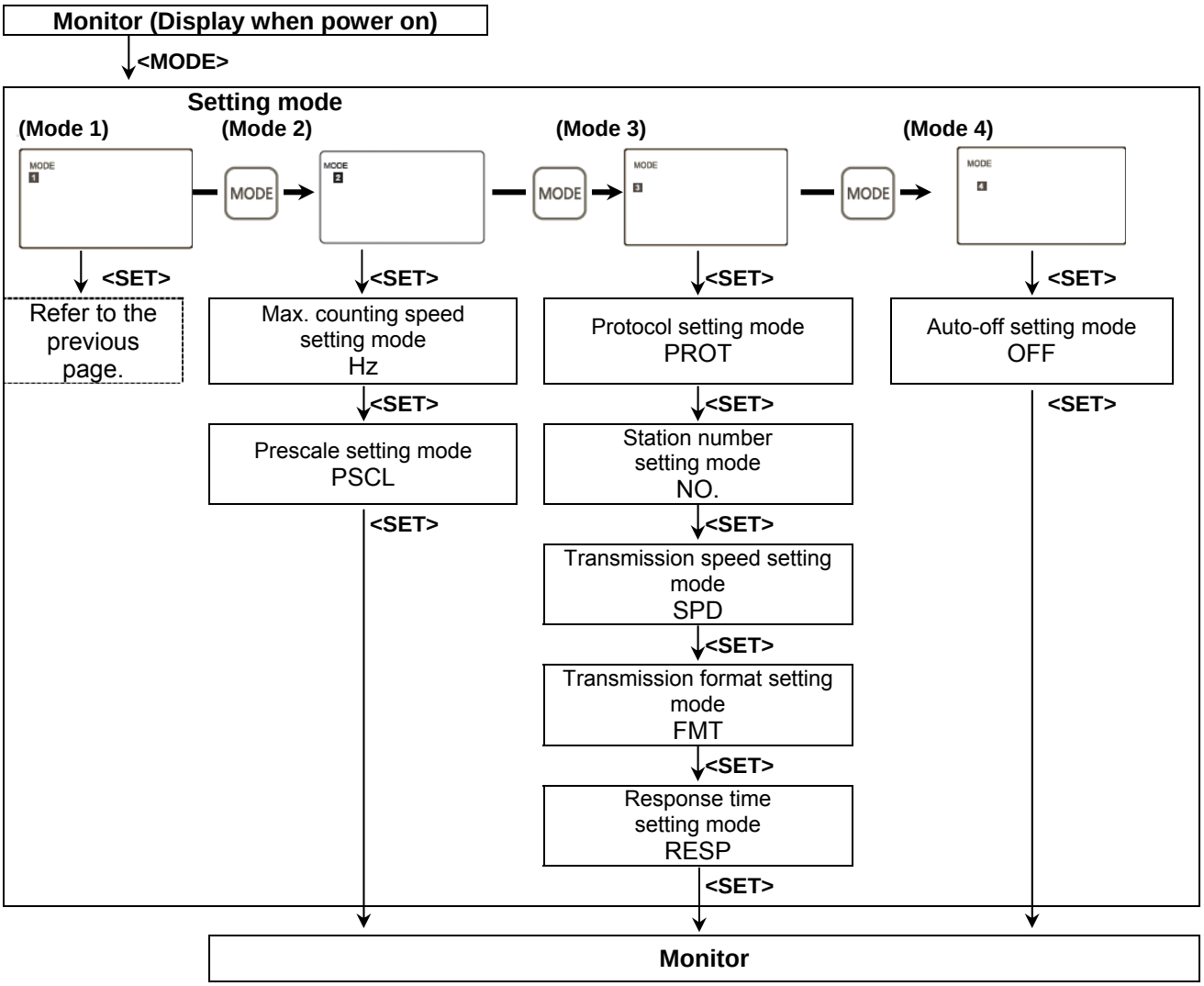
When wiring Eco-POWER METER and CT and setting mode 1 after power on, Eco-POWER Meter can measure the electric power. In order to use the other functions, set mode2, 3 and 4 according to your use.



Press <MODE> to return Monitor.

Note) Press <MODE> and <SET> at the same time, the setting will be initialized.

Mode 2…Mode for setting of each parameter for pulse measurement
Mode 3…Mode for setting of each parameter for serial communication
Mode 4…Mode for setting of each parameter for optional function



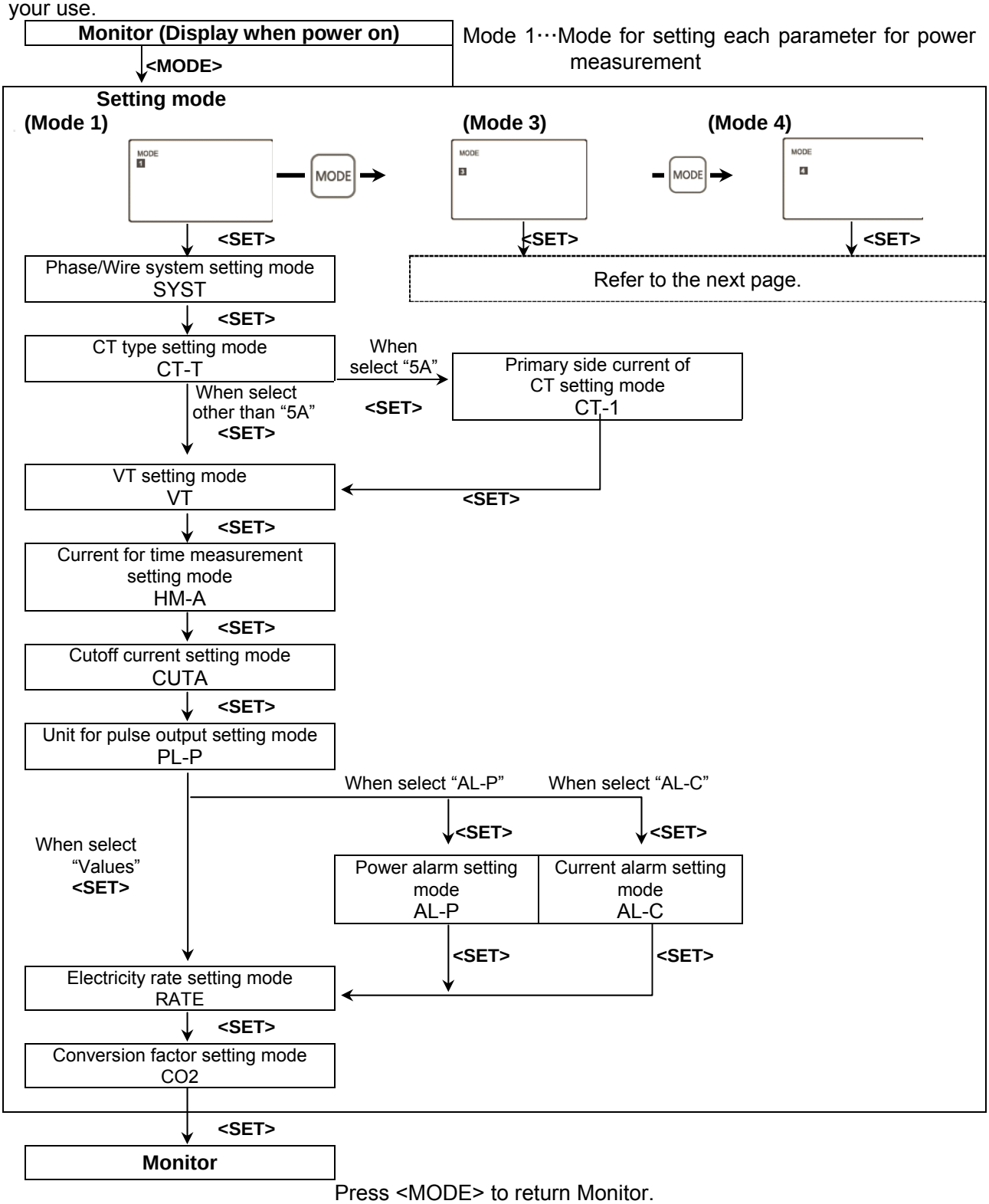
Press <MODE> to return Monitor.

Note) Press <MODE> and <SET> at the same time, the setting will be initialized.

4.2 Operation procedure AKW1110

【Basic setting to measure】

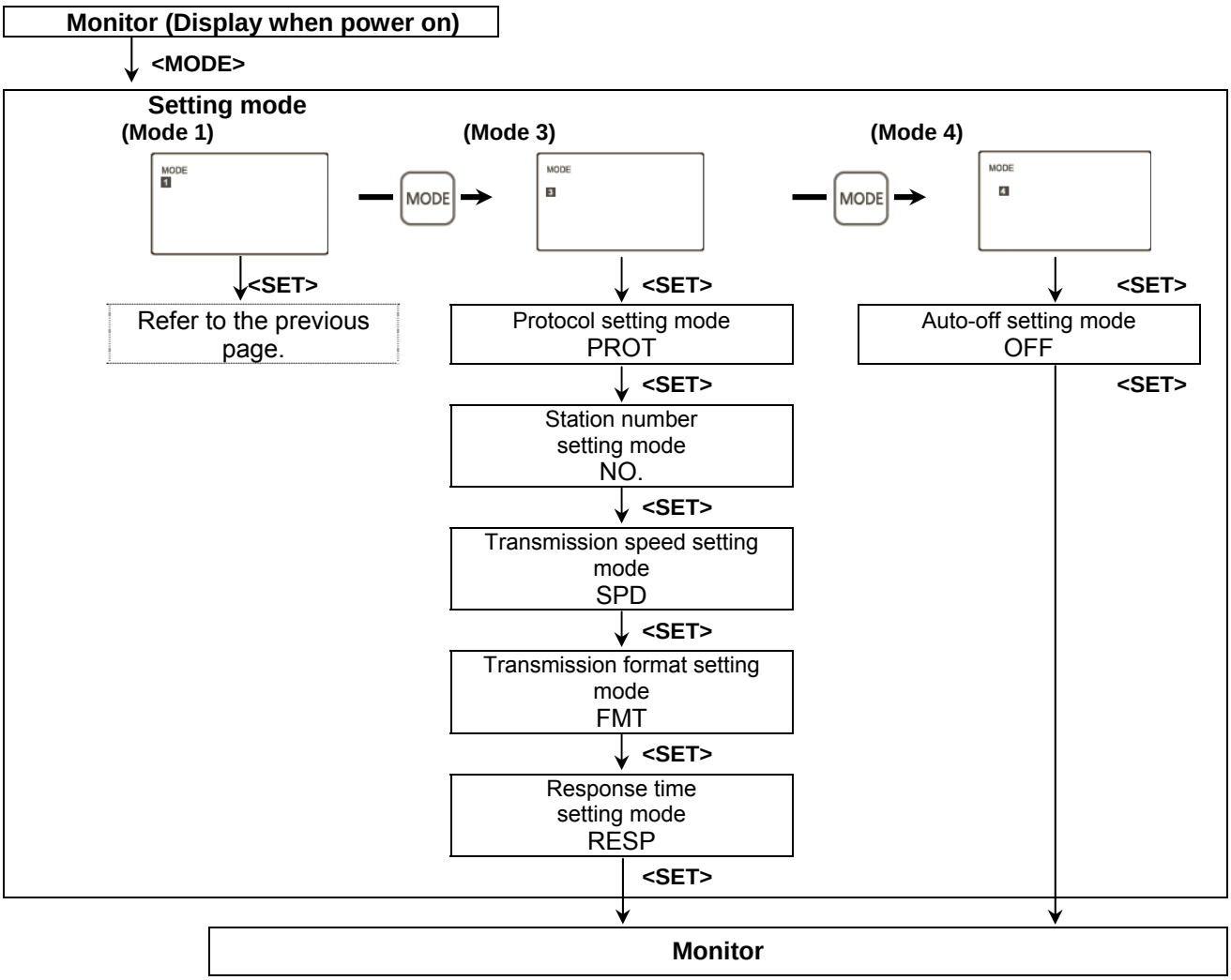
When wiring Eco-POWER METER and CT and setting mode 1 after power on, Eco-POWER Meter can measure the electric power. In order to use the other functions, set mode2, 3 and 4 according to your use.



Press <MODE> to return Monitor.

Note) Press <MODE> and <SET> at a time, the setting will be initialized.

Mode 3…Mode for setting of each parameter for serial communication
Mode 4…Mode for setting of each parameter for optional function



Press <MODE> to return Monitor.
Note) Press <MODE> and <SET> at a time, the setting will be initialized.

4.3 Setting Mode Explanation

■The value with under line is initial setting among each setting value. ☆Set before measurement.
Press <MODE> and <SET> at a time, the setting will be initialized.

4.3.1 MODE1(Mode for setting each parameter for power measurement.)

Phase/Wire system setting mode SYST

Mode defines phase and wire system to measure.

・Select from Single-phase 2-wire / Single-phase 3-wire / Three-phase 3-wire / Three-phase 4-wire. Select the system of the measured load.

＊“Three-phase 4-wire” is only for AKW1111.

CT type setting mode CT-T

Mode defines input current type of the dedicated CT.

Select from the type of 5A/50A/100A/250A/400A/600A.

When the secondary current of CT is 5A, select “5A”.

Primary side current of CT setting mode CT-1

*Only when “5A” is selected on CT type setting mode.

Mode defines primary side current when measuring by combination with existing CT, its secondary current of 5A.

It is possible to use as the second step for combination with existing CT by selecting “5A” in the CT type setting mode. In this case, it is necessary to set the primary side current.

・Primary side current of the existing CT can be set the range of 1 to 4000 (Initial 5).

・When connecting 5ACT directly and measure with 5A range, set to “5”.

ex) If primary current of measured existing CT is 400A (secondary side is 5A), set to “400”.

Voltage range setting mode VOLT ＊only AKW1111

Mode defines voltage range of Eco-Power Meter.

Select from 400/200.

When it measures load of 400V system, select “400”.

When it measures load of 100/200V system, select “200”.

＊In case measuring the load of 100/200V system with selecting “400”, the resolution will be down. Select the correct voltage range.

VT setting mode VT

Mode defines voltage input method to the main unit, input voltage directly or uses a voltage transformer (VT) (over 440V system).

・It can be set the range of 1.00 to 99.99.

“1.00” should be set when voltage input directly without connecting VT.

“1.01 to 99.99” should be set when VT is used to input voltage.

Current for time measurement setting mode HM-A

Mode defines for time measured current. It measures ON-time and OFF-time by setting value.

・It can be set the range of 1.0% to 100.0%F.S.

ex) When 10.0 is set, the current exceeds 10.0%F.S is measured as ON-time, the current under 10.0%F.S is measured as OFF-time.

＊Measured current is the current of CT1.

Cutoff current setting mode CUTA

Mode defines load current that does not measure (Cutoff current).

Use to avoid miss-measurement by wiring or induction noise at no-load.

0.00kW is displayed for instantaneous electric power, 0.0A is displayed for current. Integral electric power is not added.

・It can be set the range of 1.0% to 50.0%.

ex) When set to 10.0, current (=power) under 10.0%F.S is not added.

Unit for pulse output setting mode PL-P

Mode defines unit used for pulse output. It defines the unit of integral electric power for 1-pulse output.

・Select from 0.001/0.01/0.1/1/10/100kWh /AL-P/AL-C/AL-S/Cnt.

＊"AL-S" and "Cnt" are only for AKW1111.

When one of the "0.001/0.01/0.1/1/10/100" [kWh] is set, one pulse is output at reaching the setting value.

When "AL-P" is set, alarm is output at the time when instantaneous electric power is over the setting value.

When "AL-C" is set, alarm is output at the time when current is over the setting value.

When "AL-S" is set, alarm is output at the time when current is under the setting value and it passes the setting time.

When "Cnt" is set, it output at the time when count value reaches preset value set by preset value setting mode.

Power alarm setting mode AL-P

＊Only when "AL-P" is selected on unit for pulse output setting mode.

Mode defines instantaneous electric power used for alarm output.

・It is set the range of 0.00 to 9999.99kW.

Current alarm setting mode AL-C

＊Only when "AL-C" is selected on unit for pulse output setting mode.

Mode defines the ratio of current used for alarm output. (Ratio for the rated current)

・It is set the range of 1.0 to 100.0%.

Stand-by alarm setting mode 1 AL-S1 ＊only AKW1111

＊Only when "AL-S" is selected on unit for pulse output setting mode.

Mode defines the ratio of current used for threshold value to judge stand-by power. (Ratio for the rated current)

・It is set the range of 1.0～100.0%.

Stand-by alarm setting mode 2 AL-S2 ＊only AKW1111

＊Only when "AL-S" is selected on unit for pulse output setting mode.

Mode defines the time used for threshold value to judge stand-by power.

・It is set the range of 0 to 9999min.

When "0" is set, alarm is always output at the time when judging the stand-by power.

When "1 to 9999" is set, alarm is output at the time when passing the setting time with the stand-by power.

The alarm can be reset by pressing <SET> with the instantaneous electric power display. After reset the alarm, start to monitor the stand-by power again.

Preset value setting mode Cnt ＊only AKW1111

＊Only when "Cnt" is selected on unit for pulse output setting mode.

Mode defines count value used for output.

・It is set the range of 0(0.000) to 999999(999.999).

＊The range differs according to the pre-scale set by pre-scale setting mode.

Electricity charge setting mode RATE

Mode defines electricity charge ratio used as a standard per 1kWh.

・It can be set the range of 0.00 to 99.99 /1kWh. (Initial 10.00)

Conversion factor setting mode CO2

Mode defines conversion factor of carbon dioxide used as a standard per 1kWh.

・It can be set the range of 0.000～9.999/1kWh. (Initial 0.410)

Mode1 Setting flow chart

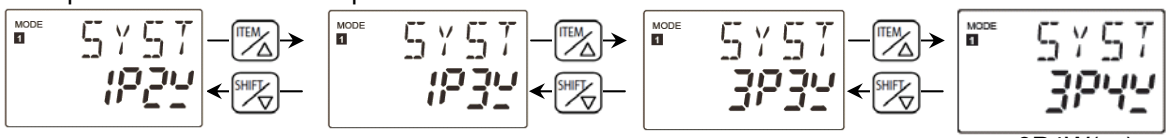
Monitor

↓ <MODE> (MODE 1 Lighting)

↓ <SET>

Phase/Wire system setting mode

Press <ITEM/△><SHIFT/▽> to change Single-phase 2-wire ⇔ Single-phase 3-wire ⇔ Three-phase 3-wire ⇔ Three-phase 4-wire.



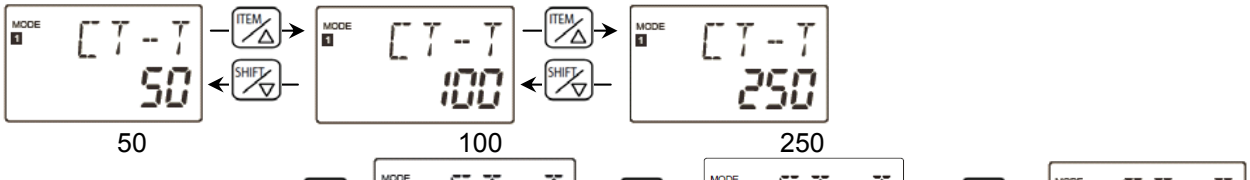
1P2W　1P3W　3P3W　3P4W(＊)

＊only AKW1111

↓ <SET>

CT type setting mode

Press <ITEM/△><SHIFT/▽> to change 50 ⇔ 100 ⇔ 250 ⇔ 400 ⇔ 600 ⇔ 5.



↓ <SET>

Primary side current of CT setting mode *It is only when “5A” is selected on CT type setting mode.

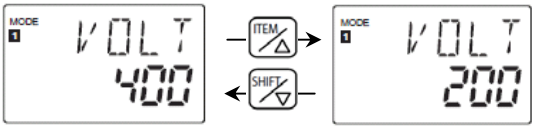
Set primary side current of CT using <ITEM/△><SHIFT/▽>.
If measured CT is 100A/5A, set to 100. If 5A is measured, set to 5.

(1 to 4000, Initial 5)

↓ <SET>

Voltage range setting mode **＊only AKW1111**

Press <ITEM/△><SHIFT/▽> to change 400V ⇔ 200V.



400V　200V

↓ <SET>

VT ratio setting mode

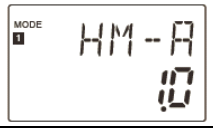
Set VT ratio using <ITEM/△><SHIFT/▽>. If the VT is 440/110, set to “4.00”.

(1.00 ～ 99.99)

↓ <SET>

Current for time measurement setting mode

Set ratio of current for time measurement using <ITEM/△><SHIFT/▽>.
If you measure the current over 50.0%F.S., set to “50.0”.



(1.0 to 100.0)

⬇ <SET>

Cutoff current setting mode

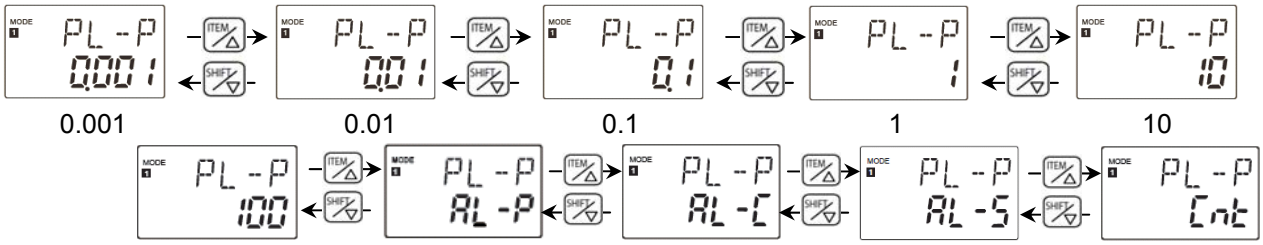
Set cutoff current ratio using <ITEM/△> <SHIFT/▽>.
If you don’t measure the current under 10.0%F.S, set to “10.0”.

(1.0 to 50.0)

⬇ <SET>

Unit for pulse output setting mode

Press <ITEM/△><SHIFT/▽> to change 0.001 ⇔ 0.01⇔ 0.1⇔ 1 ⇔ 10 ⇔ 100 ⇔ AL-P (Power alarm) ⇔ AL-C(Current alarm)⇔ AL-S (Stand-by alarm)⇔ Cnt (Count output).

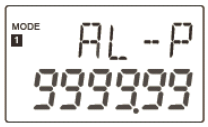


∗only AKW1111

⬇ <SET>

Power alarm setting mode *It is only when “AL-P” is selected on unit for pulse output setting mode.

Set power for alarm using <ITEM/△><SHIFT/▽>.



(0.00 to 9999.99)

⬇ <SET>

Current alarm setting mode *It is only when “AL-C” is selected on unit for pulse output setting mode.

Set current ratio (for the rated current) for alarm using <ITEM/△><SHIFT/▽>.

(1.0 to 100.0)

⬇ <SET>

Stand-by alarm setting mode 1 *It is only when “AL-S” is selected on unit for pulse output setting mode.

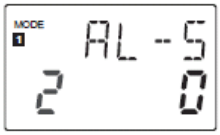
Set a ratio (for the rated current) of current used for threshold value to judge stand-by power using <ITEM/△><SHIFT/▽>.

(1.0 to 100.0)

⬇ <SET>

Stand-by alarm setting mode 2 *It is only when “AL-S” is selected on unit for pulse output setting mode.

Set a time used for threshold value to judge stand-by power using <ITEM/△><SHIFT/▽>.



(0 to 9999 min.)

*It is only when “AL-S” is selected on unit for pulse output setting mode.

“0”: Alarm is always output at the time when judging the stand-by power.

“1 to 9999”: Alarm is output at the time when passing the setting time with the stand-by power.

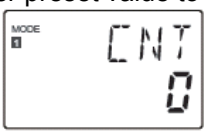
The alarm can be reset by pressing <SET> **with the instantaneous electric power display**.

After reset the alarm, start to monitor the stand-by power again.

↓ <SET>

Preset value setting mode *It is only when “Cnt” is selected on unit for pulse output setting mode.

Enter preset value to output using <ITEM/△><SHIFT/▽>.



(0 to 999999)

↓ <SET>

Electricity charge setting mode

Enter the rate per 1kWh using <ITEM/△><SHIFT/▽>.

(0.00 to 99.99 initial: 10.00)

↓ <SET>

Conversion factor setting mode

Enter the conversion factor per 1kWh using <ITEM/△><SHIFT/▽>.

(0.000 to 9.999 initial:0.410)

↓ <SET>

Monitor

4.3.2 MODE2 (Mode for setting of each parameter for pulse measurement)

＊ Only AKW1111 (400VAC applicable type)

Max. counting speed setting mode Hz

Mode defines max. counting speed.

・Select from 2kHz/30Hz

Pre-scale setting mode PSCL

Mode defines pre-scale value used for changing count value.

・It can be set the range of 0.001 to 100.000. (Initial 1.000)

・The position of decimal point set with this mode is applied to count value and preset value.

ex) When 0.01 (Last 2-digit) is set, the decimal point of count value and preset value has 2 digit under decimal point.

Mode2 Setting flow chart

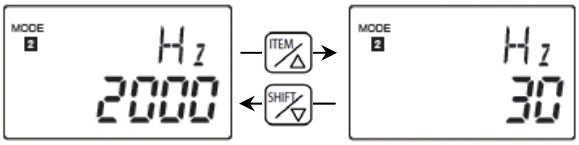
Monitor

↓ **<MODE> (MODE 2 Lighting)**

↓ **<SET>**

Max. counting speed setting mode

Press <ITEM/△><SHIFT/▽> to change 2000(2kHz) ⇔ 30（30Hz）.



2000(2kHz) 30(30Hz)

↓ **<SET>**

Pre-scale setting mode

Set pre-scale value using <ITEM/△><SHIFT/▽>.

(0.001 to 100.000, initial 1.000)

＊ The decimal point set with this mode is applied to count value and preset value.

↓ **<SET>**

Monitor

4.3.3 MODE3 (Mode for setting of each parameter for serial communication)

Protocol setting mode PROT

Mode defines communication protocol of main unit via serial communication (RS485).

・Select from MEWTOCOL / MODBUS(RTU).

Station number setting mode NO

Mode defines an individual station no. for each unit when two or more units communicate via serial communication (RS485).

・It can be set the range of 01 to 99.

Transmission speed (Baud rate) setting mode SPD

Mode defines serial communication (RS485) transmission speed. Define the transmission speed according to the master's (PLC etc.).

・Select from 2400 / 4800 / 9600 / 19200 / 38400 [bps].

Transmission format setting mode FMT

Mode defines serial communication (RS485) transmission format (Data length, Parity). Define the transmission format according to the master's (PLC etc).

・Select from 8bit-o/7bit-n/7bit-E/7bit-o/8bit-n/8bit-E.

"n (none)" means parity is not available.

"E (Even)" means parity is even number.

"o (odd)" means parity is odd number.

＊With MODBUS(RTU) protocol, it works only with 8bit.

Response time setting mode RESP

Mode defines serial communication (RS485) response time of main unit.

When command is received, it sends response after setting response time passes.

・It can be set the range of 1 to 99 ms.

MODE3 Setting flow chart

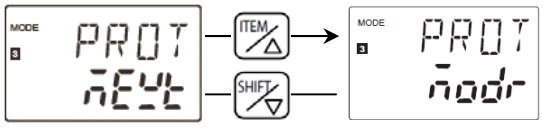
Monitor

↓ **<MODE> (MODE 3 Lighting)**

↓ **<SET>**

Protocol setting mode

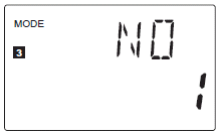
Press <ITEM/△><SHIFT/▽> to change MEWTOCOL ⇔ MODBUS(RTU).



↓ **<SET>**

Station number setting mode

Enter the station number using <ITEM/△><SHIFT/▽>.

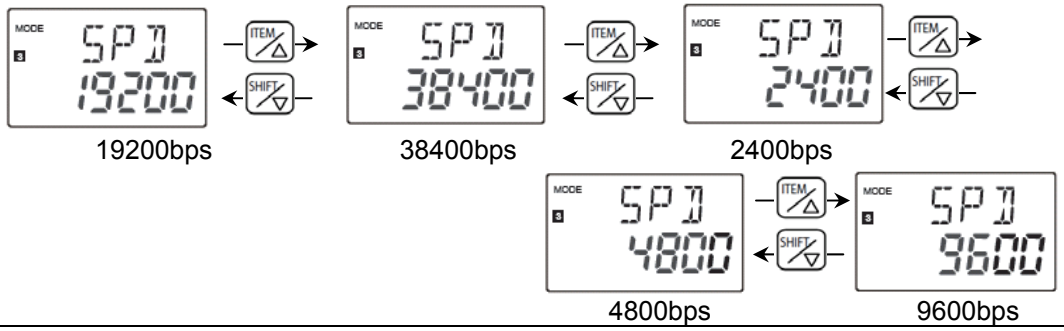


(1 to 99)

↓ **<SET>**

Transmission speed setting mode

Press <ITEM/△><SHIFT/▽> to change 19200 ⇔ 38400 ⇔ 2400 ⇔ 4800 ⇔ 9600.



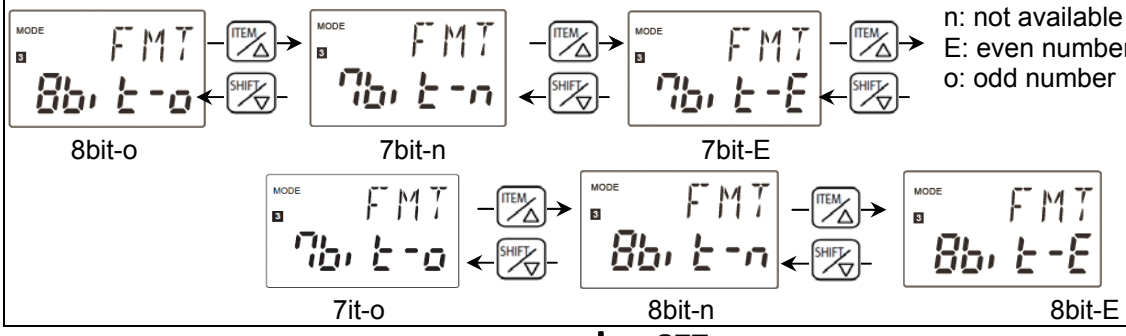
19200bps　38400bps　2400bps　4800bps　9600bps

<SET>

Transmission format setting mode

Press <ITEM/△><SHIFT/▽> to change 8bit-o ⇔ 7bit-n ⇔ 7bit-E ⇔ 7it-o ⇔ 8bit-n ⇔ 8bit-E.

n: not available
E: even number
o: odd number

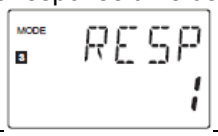


8bit-o　7bit-n　7bit-E　7it-o　8bit-n　8bit-E

<SET>

Response time setting mode

Set the response time using <ITEM/△><SHIFT/▽>.



(1 to 99ms)

<SET>

Monitor

4.3.4 MODE4 (Mode for setting of each parameter for optional function)

Auto-off setting mode　　OFF

Display LCD turns off automatically when there is no key operation for a long time.

・Off time can be set the range of 0 to 99min.
"0" should be set if you want to turn always light on.
"1~99" should be set if you want to turn light off at setting time.
・After turns off the LCD, any key operation makes it turns on.
・After turns off the LCD, only power indicator turns on.

MODE4 Setting flow chart

Monitor

↓ **<MODE>　(MODE 4 Lighting)**

↓ **<SET>**

Auto-off setting mode

Enter auto-off time by minute using <ITEM/△><SHIFT/▽>.

(0 to 99)
"0" should be set to turn always light on.
"1~99" should be set to turn light off at setting time (minute).
While light off, press any key to light on.

↓ **<SET>**

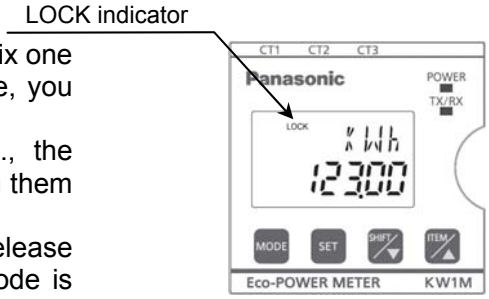
Monitor

Chapter 5 Various Functions

(Sample image is AKW1111. AKW1110 displays same.)

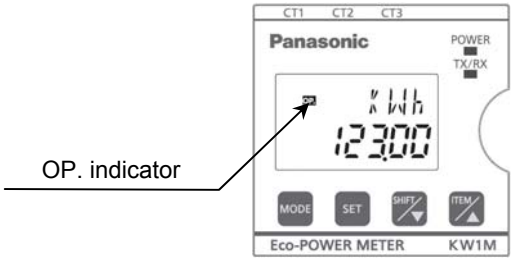
5.1 LOCK mode

It is the mode makes all keys unable. Use when you want to fix one of the measurement displays (For all displays). In this mode, you can not input by any keys.
When you press <SET>key continuously for about 3sec., the “LOCK” indicator lights and all keys become locked (pressing them will have no effect).
Press <SET>key continuously for about 3sec. again to release Lock mode. The “LOCK” indicator goes off and the lock mode is released (unlocked).



5.2 Pulse output function

OP. (output) indicator is lighting when pulse output.
Refer to Mode1 setting.



5.2.1 Output depends on integral electric power

Set the unit for pulse output (0.001/0.01/0.1/1/10/100kWh) and pulse output (transistor output) turns on every time when integral electric power reaches the unit. (Pulse width: about 100ms)

5.2.2 Instantaneous electric power alarm

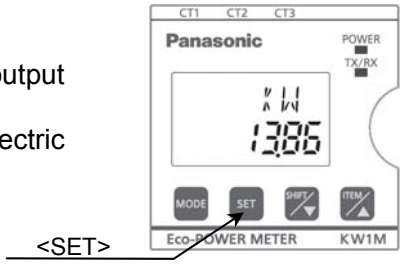
When it exceeds the setting instantaneous electric power, pulse output (transistor output) turns on in order to notice. When it falls below, the output turns off.

5.2.3 Current alarm

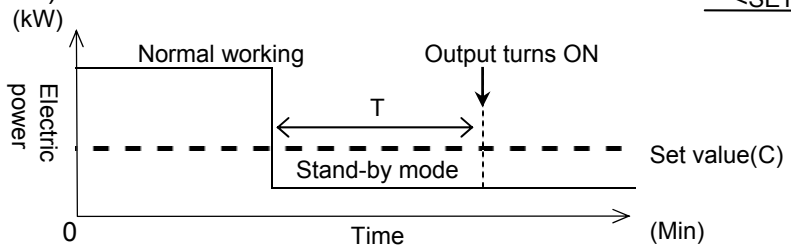
When it exceeds the setting current ratio, pulse output (transistor output) turns on in order to notice. When it falls below, the output turns off.

5.2.4 Stand-by power alarm *only AKW1111

When it detects stand-by power (current) of the measured load, pulse output (transistor output) turns on in order to notice.
Set current (C) and stand-by time (T) to judge stand-by power.
When the measured load is satisfied the setting conditions, pulse output (transistor output) turns on in order to notice.
You can reset the alarm by pressing <SET> with the instantaneous electric power display.



(Working flow chart)



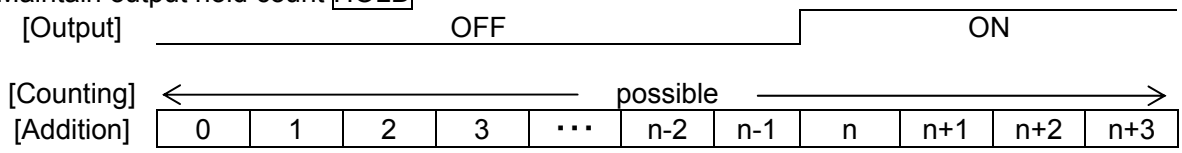
5.2.5 Output depends on count value *only AKW1111

Set the preset value and pulse output (transistor output) turns on the time when count value reaches the preset value.

5.3 Counter function　　*only AKW1111 (400VAC applicable type)

5.3.1 Operation mode

Maintain output hold count HOLD



(1) Output control is maintained after count-up completion and until reset. However counting is possible despite of count-up completion.

(2) It reverts“0” after counting up full scale, but output control is maintained. However output is OFF if count value or preset value is changed.

5.3.2 Change the Preset Value

It is possible to change the preset value even during counting. However note the following points.

◇When the pre-scale value is “1.000”.（PSCL=1.000）

(1) If the preset value is changed to the value less than the count value, counting will continue until it reaches full scale, returns to “0” and then reaches the new preset value.

(2) If the preset value is changed to “0”, it will not count up at start with “0”. It counts up when the counting value comes to “0” again (after reach to full scale). However output is OFF if count value or preset value is changed.

(3) When the count value is fixed, output is changed according to the changing of preset value as below.

①If the preset value is changed to the value less than the count value or same as count value, output is ON.

（Count value ≧ Preset value）

②If the preset value is changed to the value more than the count value, output is OFF.

（Count value ＜ Preset value）

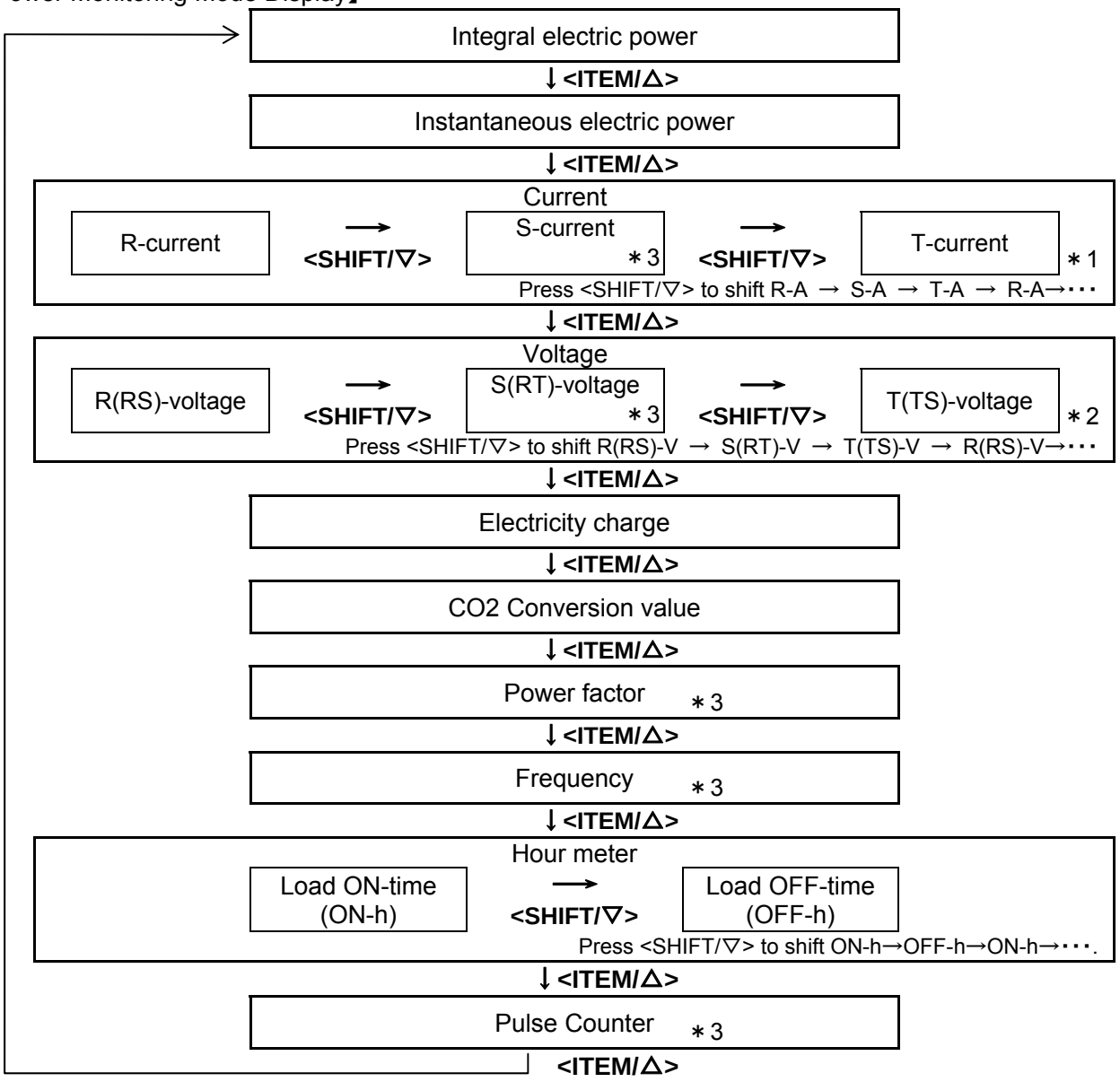
◇When the pre-scale is not “1.000”.（PSCL≠1.000）

Even if the preset value is changed after counting to full scale, output is not changed.

Chapter 6 Display of each Value

6.1 Working of Monitor Display

【Power Monitoring Mode Display】



＊1,2 The display is changed according to the phase and wire system.

	Current	Voltage		
1P2W system	R-current	R-voltage		
1P3W system	R-current T-current	R-voltage, T-voltage (P1-P0) (P2-P0)		
3P3W system	R-current, S-current, T-current	RS-voltage, (P1-P0)	RT-voltage, (P1-P2)	TS-voltage (P2-P0)
3P4W system (＊3)	R-current, S-current, T-current	R-voltage, (P1-P0)	S-voltage, (P2-P0)	T-voltage (P3-P0)

＊3 Only AKW1111 (400V AC applicable type)

6.2 Power Monitoring mode

(Sample image is AKW1111. AKW1110 displays same.)
Power on the unit and it displays the integral electric power.

6.2.1 Integral electric power

・It displays the integral electric power.

Sample

kWh

MWh

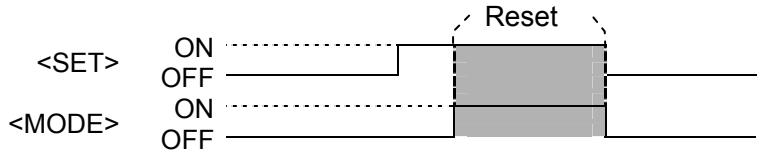
・Integral electric power is measured and displayed from 0.00kWh to 9999.99MWh.
・The decimal point is changed automatically.

kWh kWh kWh kWh MWh MWh
0.00 → 9999.99 → 10000.0 → 99999.9 → 100.00 → 9999.99

(After reaching the full scale (99999.9kWh), the value reverts to 0.00kWh but continues to measure.)

How to reset

・Hold down <SET> and press <MODE> makes integral electric power clear.



How to display with 9-digit

Integral electric power can be displayed with 9-digit.
・Press <SHIFT/▽> and <ITEM/△> simultaneously at integral electric power display (kWh/MWh) and integral electric power with 9-digit is displayed.

Sample: 6-digit (MWh)

6.2.2 Instantaneous electric power

・It displays the Instantaneous electric power.

Sample Instantaneous electric power (kW)

6.2.3 Current

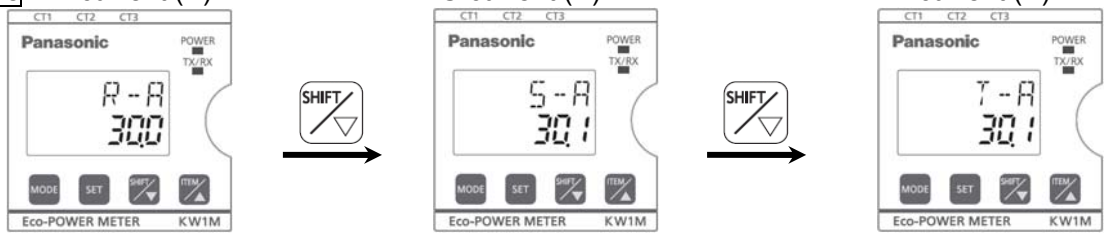
・It displays the current value of the load.

・Press <SHIFT/▽> to change R-current and S-current (＊), T-current.

＊only AKW1111 (400V AC applicable type)

*Before start measuring, select phase and wire system according to the measured load.
When it sets wrong, it doesn't measure correctly. (Refer to the explanation of setting mode.)

Sample R-current (A) S-current (A) ＊ T-current (A)



・When input current is under the setting cut-off current, it displays "0.0" and doesn't measure.

・When input current exceeds 150%F.S. at each range,「- - - - - -」will be displayed.

・Current measurement parts

Eco-POWER METER measures the current as below.

<AKW1111 (400VAC applicable type)>

Display / System	R-A	S-A	T-A
Single-phase two-wire	R-current	(Skip)	(Skip)
Single-phase three-wire	R-current	(Skip)	T-current
Three-phase three-wire	R-current	S-current	T-current
Three-phase four-wire	R-current	S-current	T-current

<AKW1110>

Display / System	R-A	T-A
Single-phase two-wire	R-current	(Skip)
Single-phase three-wire	R-current	T-current
Three-phase three-wire	R-current	T-current

6.2.4 Voltage

・It displays the voltage value of the load.

・Press <SHIFT/▽> to change voltage between R(RS)-voltage(＊) and T(TS)-voltage.

＊only AKW1111 (400V AC applicable type)

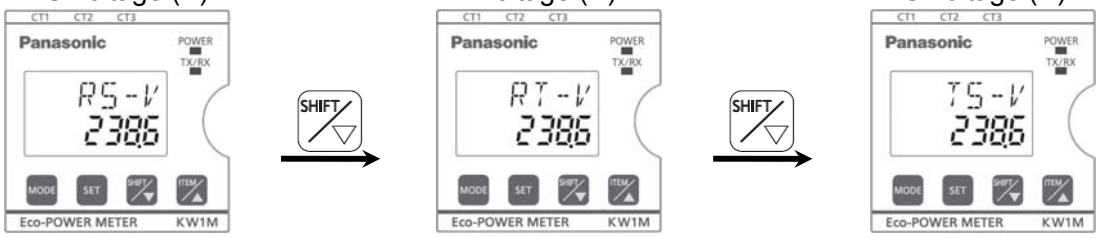
*Before start measuring, select phase and wire system according to the measured load.
When it sets wrong, it doesn't measure correctly. (Refer to the explanation of setting mode.)

Sample for 1P2W/1P3W/3P4W

R-voltage (V) S-voltage (V) ＊ T-voltage (V)

Sample for 3P3W

RS-voltage (V) RT-voltage (V) ＊ TS-voltage (V)



・When input voltage is under 5% of rating, it displays "0.0" and doesn't measure.
("Under 5%" means the value getting from this calculation "rated voltage 200(400) x 0.05 x VT ratio".)

・When input voltage exceeds 150%F.S. at each range, 「- - - - - -」 will be displayed.

・Voltage measurement parts

Eco-POWER METER measures the voltage as below.

<AKW1111 (400VAC applicable type)>

Display / System	R-V / RS-V	S-V / RT-V	T-V / TS-V
Single-phase two-wire	R-voltage (P1-P0) (line voltage)	(Skip)	(Skip)
Single-phase three-wire	R-voltage (phase voltage)	(Skip)	T-voltage (phase voltage)
Three-phase three-wire	RS-voltage (P1-P0) (line voltage)	RT-voltage(P1-P2) (line voltage)	TS-voltage (P2-P0) (line voltage)
Three-phase four-wire	R-voltage (phase voltage)	S-voltage (phase voltage)	T-voltage (phase voltage)

<AKW1110>

Display / System	R-V / RS-V	T-V / TS-V
Single-phase two-wire	R-voltage (P1-P0) (line voltage)	(Skip)
Single-phase three-wire	R-voltage (phase voltage)	T-voltage (phase voltage)
Three-phase three-wire	RS-voltage (P1-P0) (line voltage)	TS-voltage (P2-P0) (line voltage)

6.2.5 Electricity Charge

・It displays the standard electricity charge for the integral electrical power.

Sample

＊When the value exceeds ‘999999’,
「- - - - - -」will be displayed.

6.2.6 Carbon dioxide conversion value

・It displays the standard conversion value for the integral electrical power.

Sample CO_2 conversion value (kg-CO_2)

＊When the value exceeds ‘999999’,
「- - - - - -」will be displayed.

6.2.7 Power factor *only AKW1111

・It displays power factor of the load.

Sample

Lagging phase

Leading phase

・How to calculate power factor

Eco-POWER METER displays power factor by calculating as below.
Power factor operation is a method assuming balanced load. The error might be big when it measures unbalanced load.

Single-phase two-wire	$PF = \frac{\text{Instantaneous electric power}}{\text{Voltage} \times \text{Current}}$	
Single-phase three-wire Three-phase four -wire	$PF = \frac{\text{Instantaneous electric power}}{a \times \left(\text{Average of each phase V}\right) \times \left(\text{Average of each phase A}\right)}$	1P3W: a=2 3P4W: a=3
Three-phase three -wire	$PF = \frac{\text{Instantaneous electric power}}{\sqrt{3} \times \left(\text{Average of each phase V}\right) \times \left(\text{Average of each phase A}\right)}$	

6.2.8 Frequency *only AKW1111

・It displays the frequency.

Sample Frequency (Hz)

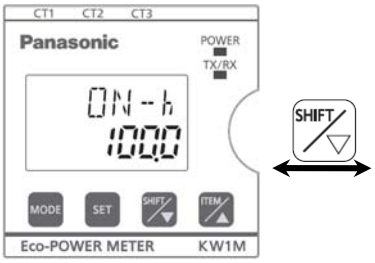
6.2.9 Hour meter

・It displays ON-time and OFF-time of the load.

・Press <SHIFT/▽> to change the load ON-time to load OFF-time.

Sample

ON-time (h)



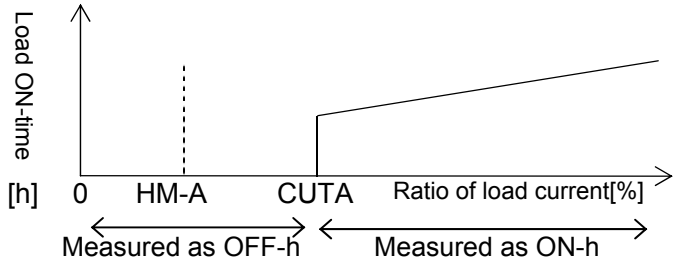
Blinking the decimal point during measurement of ON-time.

OFF-time (h)

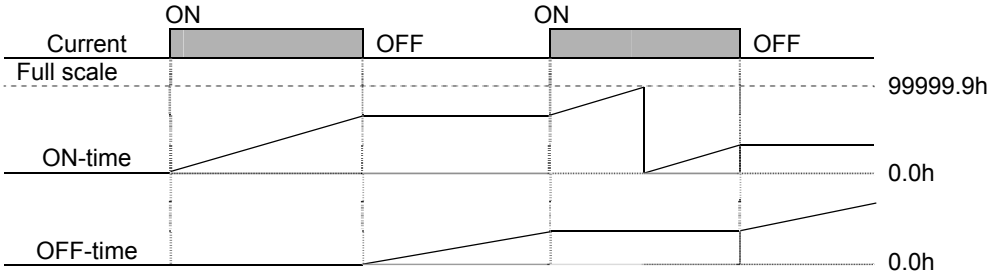
Blinking the decimal point during measurement of OFF-time.

∗ When load current is under the setting current for time measurement (HM-A), it measures as OFF-time. When load current is exceeded to the setting current for time measurement (HM-A), it measures as ON-time. Current for time measurement (HM-A) is set to under cutoff current (CUTA), all current is measured as OFF-time.

∗ Current flow of CT1

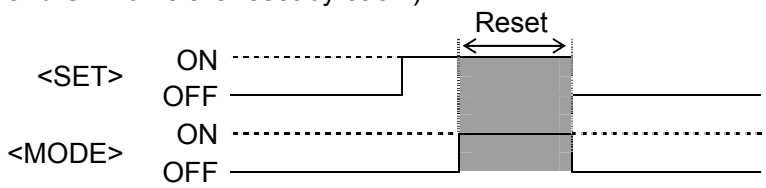


∗ After reaching the full scale (99999.9h), the value reverts to 0.0h but continues to measure.



How to Reset ON/OFF-time

・Hold down <SET>key and press <MODE>key makes ON-time or OFF-time clear.
(ON-time and OFF-time are reset by each.)



6.2.10 Counter　　*only AKW1111

・It displays present count value (pulse input value).

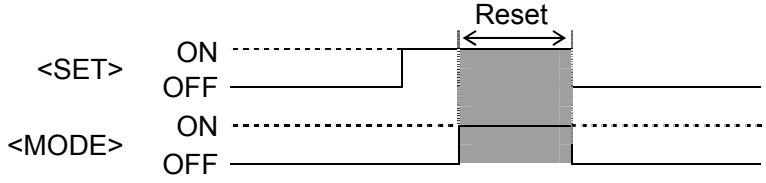
Sample

Prescale: 0.01

∗After reaching the full scale (999999), the value reverts to 0 but continues to measure.

How to Reset Count value

・Hold down <SET>key and press <MODE>key makes count value clear.

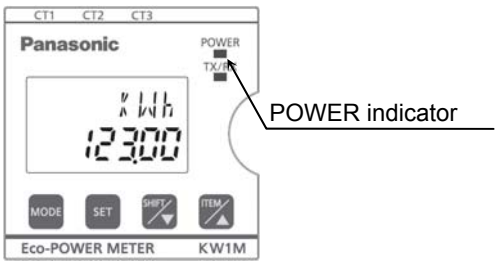


6.3 Other indication

6.3.1 Power On indication

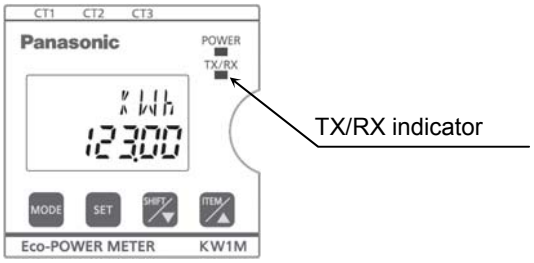
Power indicator turns on when the unit power on.

Even if the display turns off, the power indicator is lighting while a current flows to the unit.
(Refer to Mode 4 setting.)



6.3.2 Indication while communication

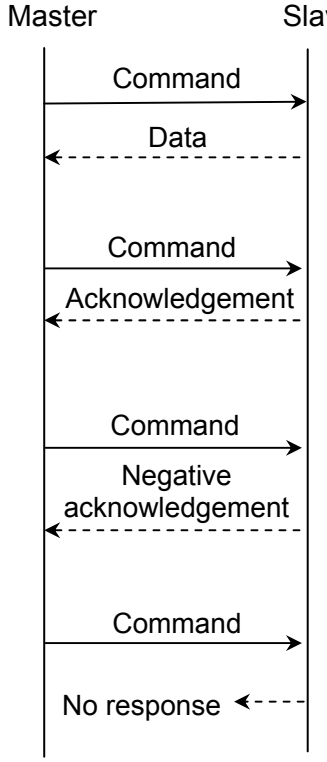
TX/RX indicator is blinking while Eco-POWER METER is under communication.



Chapter 7 Communication

7.1 Communication Procedures

Communication starts with command transmission from the host computer (hereafter Master) and ends with the response of Eco-POWER METER (hereafter Slave).



• Response with data
When master sends reading command, slave responds with the corresponding set value or current status.

• Acknowledgement
When master sends setting command, slave responds by sending the acknowledgement.

• Negative acknowledgement
When master sends a non-existent command or value out of the setting range, the slave returns negative acknowledgement.

• No response
Slave will not respond to master in the following cases.
- Global address “FF” (MEWTOCOL) is set.
- Broadcast address “00H” (Modbus protocol) is set.
- Communication error (framing error, parity error)
- CRC-16 discrepancy (Modbus RTU mode)

7.2 Communication timing

◆The minimum access time from the master is 1 sec. (Minimum time for update the data)
Eco-POWER METER may not response due to noise and so on, be sure to check that it receives the response from Eco-POWER METER.

◆In order to improve the communication quality, we recommend to send the transmission again.

Communication timing of RS485

◇Eco-POWER METER (Slave) side

When Eco-POWER METER (Slave) starts transmission to RS485 communication line, it is arranged so as to provide an idle status transmission period of about 1 to 99ms (setting available) before sending the response to ensure the synchronization on the receiving side. After sending the response, master can disconnect the transmitter from the communication line within transmission period 20ms.

◇Master side (Cautions of setting a program)

At communication, keep the following conditions.

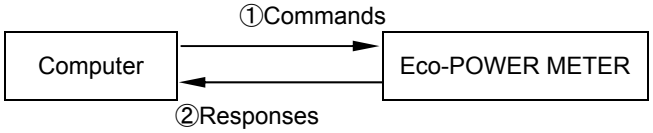
1) Set the program so that the master can disconnect the transmitter from the communication line within the transmission period of about 2ms after sending the command in preparation for reception of the response from Eco-POWER METER (Slave).
2) To avoid collision of transmissions between the master and Eco-POWER METER (Slave), send a next command after checking that the master received the response.

7.3 MEWTOCOL Communication

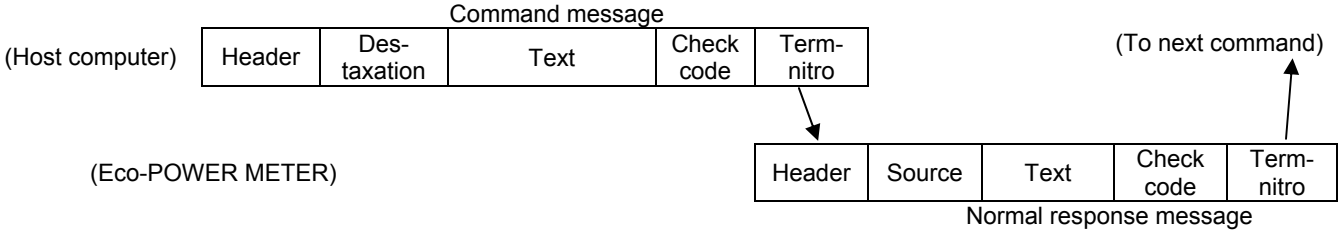
7.3.1 Overview of MEWTOCOL-COM (RS485)

◆Command and response functions

The computer sends commands (instructions) to Eco-POWER METER, and receives responses in return. This enables the computer and Eco-POWER METER to converse with each other, so that various kinds of information can be obtained and provided.



◆Command and response formats



◇Control codes

Name	Character	ASCII code	Explanation
Header	%	25H	Indicates the beginning of a message.
Command	#	23H	Indicates that the data comprises a command message.
Normal response	$	24H	Indicates that the data comprises a normal response message.
Error response	!	21H	Indicates that the data comprises a response message when an error occurs.
Terminator	CR	0DH	Indicates the end of a message.

◇Destination and source AD (H), (L)

Two-digit decimal 01 to 99 (ASCII codes)

Command messages contain a station number for Eco-POWER METER that receives the message.

When FF (ASCII code table) is used, however, the transmission is a global transmission (sent to all stations at once).

Note) When a global transmission is sent, no response to the command message is returned.

◇Block check code Bcc (H), (L)

Two- digit hexadecimal 00 to FF (ASCII codes)

These are codes (horizontal parity) that are used to detect errors in the transmitted data.

If "**" is entered instead of "Bcc", however, messages can be transmitted without the Bcc. In this case, the Bcc is included with the response

◇Error code Err (H), (L)

Two- digit hexadecimal 00 to FF (ASCII codes)

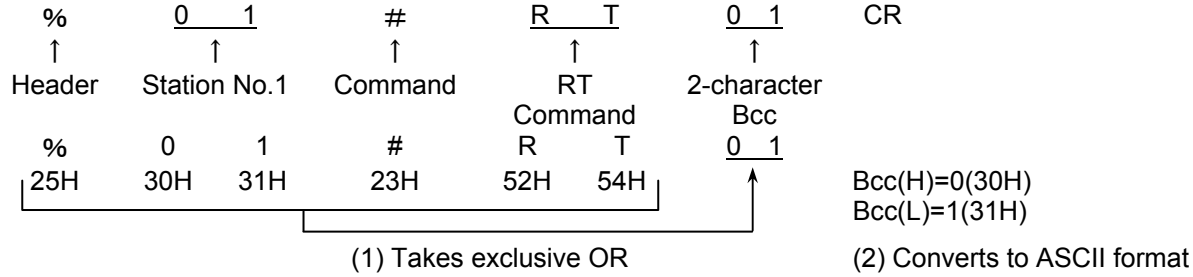
These indicate the content if an error occurs.

◆Bcc (Block Check Code)

-The Bcc is a code that carries out an error check using horizontal parity, to improve the reliability of the data being sent.

-The Bcc uses an exclusive OR from the header (%) to the final character of the text, and converts the 8- bit data into a 2-character ASCII code.

Example)



7.3.2 Data Register List <AKW1111 (400AC applicable type)>

Data register	Name	Unit	Kind of data	Range	R/W
DT00054	Rate (CHG)	0.01	Unsigned 16bit	0 to 9999	R/W
DT00055	Conversion factor (CO_2)	0.001 kg-CO^2	Unsigned 16bit	0 to 9999	R/W
DT00060	CT type	Rated A (rms)	Unsigned 16bit	5,50,100,250,400,600	R/W
DT00061 DT00062	Unit for Pulse output	－	Unsigned 32bit	1(0.001),10(0.01),100(0.1), 1000(1),10000(10),100000(100) 999 (Instantaneous electric power: Values of DT00064, 00065) 777 (Ratio for current alarm: Value of DT00069) 555 (Preset value for output: Values of DT00158,00159) 333 (Ratio and time for Stand-by alarm: Value of DT00077,00078)	R/W
DT00063	Primary side current value when CT 5A	1A	Unsigned 16bit	1 to 4000	R/W
DT00064 DT00065	Power alarm value (Instantaneous electric power)	0.01kW	Unsigned 32bit	0 to 999999	R/W
DT00066	VT ratio	0.01	Unsigned 16bit	100 to 9999	R/W
DT00067	Current threshold for time measurement	0.1%	Unsigned 16bit	1 to 1000	R/W
DT00068	Cutoff current	0.1%	Unsigned 16bit	10 to 500	R/W
DT00069	Ratio for current alarm	0.1%	Unsigned 16bit	10 to 1000	R/W
DT00070	Voltage range	－	Unsigned 16bit	1; 400V 2; 200V	R/W
DT00077	Ratio for stand-by current	0.1%	Unsigned 16bit	10 to 1000	R/W
DT00078	Time for stand-by alarm	1min.	Unsigned 16bit	0 to 9999	R/W
DT00100 DT00101	Integral electric power	0.01kWh	Unsigned 32bit	0 to 999999999	R/W
DT00107	R-current	0.1A	Unsigned 16bit	0 to 60000	R
DT00108	S-current	0.1A	Unsigned 16bit	0 to 60000	R
DT00109	T-current	0.1A	Unsigned 16bit	0 to 60000	R
DT00111	Power factor	0.01	Signed 16bit	-99 to 100	R
DT00112	Frequency	0.1Hz	Unsigned 16bit	0 to 1000	R
DT00150 DT00151	Load ON-time	0.1h	Unsigned 32bit	0 to 999999	R/W
DT00152 DT00153	Load OFF-time	0.1h	Unsigned 32bit	0 to 999999	R/W
DT00154 DT00155	Pulse count value	－	Unsigned 32bit	0 to 999999	R/W
DT00158 DT00159	Preset value	－	Unsigned 32bit	0 to 999999	R/W
DT00160 DT00161	Prescale value	0.001	Unsigned 32bit	0 to 100000	R/W
DT00162	Max. counting speed	Hz	Unsigned 16bit	30, 2000	R/W
DT00163	Auto-off time	min	Unsigned 16bit	0 to 99 (0:always on)	R/W
DT00170 DT00171	R(RS)-voltage	0.1V	Unsigned 32bit	0 to 999999	R
DT00172 DT00173	S(RT)-voltage	0.1V	Unsigned 32bit	0 to 999999	R
DT00174 DT00175	T(TS)-voltage	0.1V	Unsigned 32bit	0 to 999999	R
DT00176 DT00177	Instantaneous electric power	0.01kW	Unsigned 32bit	0 to 999999	R

7.3.3 Data Register List <AKW1110>

Data register	Name	Unit	Kind of data	Range	R/W
DT00054	Rate (CHG)	0.01	Unsigned 16bit	0 to 9999	R/W
DT00055	Conversion factor (CO2)	0.001 kg-CO^2	Unsigned 16bit	0 to 9999	R/W
DT00060	CT type	Rated A (rms)	Unsigned 16bit	5,50,100,250,400,600	R/W
DT00061	Unit for Pulse output	—	Unsigned 32bit	1(0.001),10(0.01),100(0.1), 1000(1),10000(10),100000(100) 999 (Instantaneous electric power: Values of DT00064, 00065) 777 (Ratio for current alarm: Value of DT00069)	R/W
DT00062					
DT00063	Primary side current value when CT 5A	1A	Unsigned 16bit	1 to 4000	R/W
DT00064	Power alarm value (Instantaneous electric power)	0.01kW	Unsigned 32bit	0 to 999999	R/W
DT00065					
DT00066	VT ratio	0.01	Unsigned 16bit	100 to 9999	R/W
DT00067	Current threshold for time measurement	0.1%	Unsigned 16bit	1 to 1000	R/W
DT00068	Cutoff current	0.1%	Unsigned 16bit	10 to 500	R/W
DT00069	Ratio for current alarm	0.1%	Unsigned 16bit	10 to 1000	R/W
DT00100	Integral electric power	0.01kWh	Unsigned 32bit	0 to 999999999	R/W
DT00101					
DT00107	R-current	0.1A	Unsigned 16bit	0 to 60000	R
DT00109	T-current	0.1A	Unsigned 16bit	0 to 60000	R
DT00150	Load ON-time	0.1h	Unsigned 32bit	0 to 999999	R/W
DT00151					
DT00152	Load OFF-time	0.1h	Unsigned 32bit	0 to 999999	R/W
DT00153					
DT00163	Auto-off time	min	Unsigned 16bit	0 to 99 (0:always on)	R/W
DT00170	R(RS)-voltage	0.1V	Unsigned 32bit	0 to 999999	R
DT00171					
DT00174	T(TS)-voltage	0.1V	Unsigned 32bit	0 to 999999	R
DT00175					
DT00176	Instantaneous electric power	0.01kW	Unsigned 32bit	0 to 999999	R
DT00177					

Note1) R: Read W: Write

2) Data register except specified is 0.

3) DT00061, 00062 (Unit for pulse output) is numerical value (in the range of data register).

4) If each setting value is wrote by communication, it memories to internal EEPROM at the same time. Therefore, change setting frequently makes EEPROM's life short. Avoid to usage like this.

5) Write a data within the range when you write it.

6) Max reading point is 26 points (57 bytes), max writing point is 23 points (55 bytes).

7.3.4 Error Codes

◇Basic procedure errors

Error code	Error name	Explanation
40H	Bcc error	･A Bcc error occurred in the command data.
41H	Format error	･A command message was sent that does not fit the transmission format.
42H	No support error	･A command was sent that is not supported.
43H	Procedure error	･Delimiter with multiple frames was sent. ･The response shall be multiple frames.

◇Application error

Error code	Error name	Explanation
60H	Parameter error	･The data code is not “D”.
61H	Data error	･Word No. is specified without decimal.（0000F etc.） ･The starting word No. is bigger than the ending word No. ･Writing data has a code that is not hexadecimal.
62H	Registration error	･Too many registrations have been entered (more than 17). ･“MD” command was sent when some registration has been exist. ･“MG” command was sent when registration has not been entered.

◇Self-diagnostic error

Error code	Error name	Explanation
45H	Operation error	･At “WD” command, writing data is exceeded the range of data register.

7.3.5 Command

Eco-POWER METER has 5 kinds of commands.

Command name	Code	Explanation
Read data area	RD	Reads the contents of data area.
Write data to data area	WD	Writes data to a data area.
Resister or Reset data monitored	MD	Resisters the data to be monitored.
Monitoring start	MG	Monitors a registered data.
Read status	RT	Reads the specifications of Eco-POWER METER and error code if an error occurs.

◆[RD]: Read data area (Reads the contents of data area.)

◇Command

%	Destination ×10¹ ×10⁰	#	R	D	D	Starting word No. 5 characters ×10⁴ ×10³ ×10² ×10¹ ×10⁰	Ending word No. 5 characters ×10⁴ ×10³ ×10² ×10¹ ×10⁰	Bcc ×16¹ ×16⁰	CR

◇Normal response (Read successful)

%	Source ×10¹ ×10⁰	$	R	D	First register contents 4 characters ×16¹ ×16⁰ ×16³ ×16²	Last register contents 4 characters ×16¹ ×16⁰ ×16³ ×16²	Bcc ×16¹ ×16⁰	CR

(lower word) (higher word) (lower word) (higher word)

◇Error response

%	Source ×10¹ ×10⁰	!	Error code ×16¹ ×16⁰	Bcc ×16¹ ×16⁰	CR

(Common to each command)

◆[WD]: Write data area (Writes date to a data area.)

◇Command

%	Destination ×10¹ ×10⁰	#	W	D	D	Starting word No. 5 characters ×10⁴ ×10³ ×10² ×10¹ ×10⁰	Ending word No. 5 characters ×10⁴ ×10³ ×10² ×10¹ ×10⁰	First writing data 4 characters ×16¹ ×16⁰ ×16³ ×16²	⇒

(lower word) (higher word)

◇Normal response (Write successful)

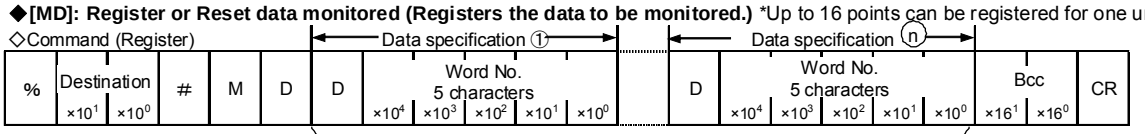
%	Source ×10¹ ×10⁰	$	W	D	Bcc ×16¹ ×16⁰	CR

⇒ Last writing data 4 characters ×16¹ ×16⁰ ×16³ ×16² | Bcc ×16¹ ×16⁰ | CR

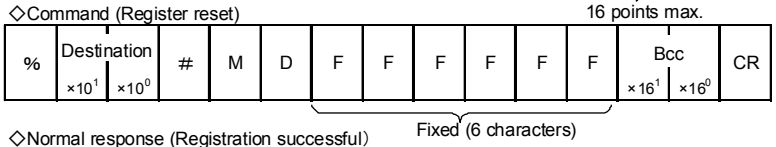
(lower word) (higher word)

◆[MD]: Register or Reset data monitored (Registers the data to be monitored.) *Up to 16 points can be registered for one unit.

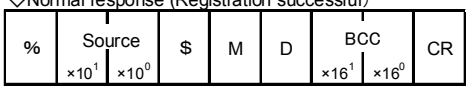
◇Command (Register)


Data specification ①
Data specification n
% Destination ×10¹ ×10⁰ # M D D Word No. 5 characters ×10⁴ ×10³ ×10² ×10¹ ×10⁰ D Word No. 5 characters ×10⁴ ×10³ ×10² ×10¹ ×10⁰ Bcc ×16¹ ×16⁰ CR

◇Command (Register reset)

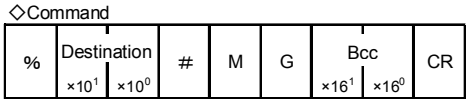


◇Normal response (Registration successful)

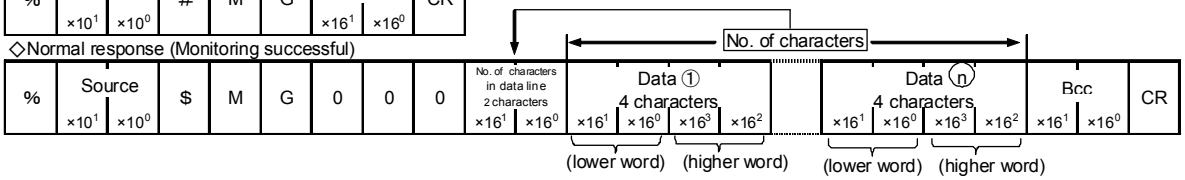


◆[MG]: Monitoring start (Monitors a registered data.)

◇Command

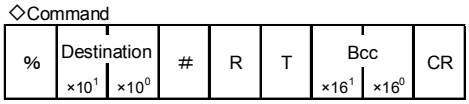


◇Normal response (Monitoring successful)

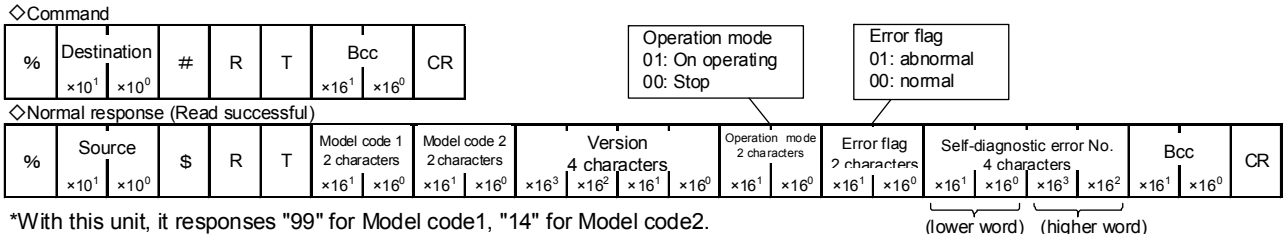

No. of characters
% Source ×10¹ ×10⁰ $ M G 0 0 0 No. of characters in data line 2 characters ×16¹ ×16⁰ Data ① 4 characters ×16¹ ×16⁰ ×16³ ×16² Data n 4 characters ×16¹ ×16⁰ ×16³ ×16² Bcc ×16¹ ×16⁰ CR
(lower word) (higher word)
(lower word) (higher word)

◆[RT]: Read the status of Eco-POWER METER (Reads the specifications of Eco-POWER METER and error codes if an error occurs.)

◇Command



◇Normal response (Read successful)


Operation mode 01: On operating 00: Stop
Error flag 01: abnormal 00: normal
% Source ×10¹ ×10⁰ $ R T Model code 1 2 characters ×16¹ ×16⁰ Model code 2 2 characters ×16¹ ×16⁰ Version 4 characters ×16³ ×16² ×16¹ ×16⁰ Operation mode 2 characters ×16¹ ×16⁰ Error flag 2 characters ×16¹ ×16⁰ Self-diagnostic error No. 4 characters ×16¹ ×16⁰ ×16³ ×16² Bcc ×16¹ ×16⁰ CR
(lower word) (higher word)

*With this unit, it responses "99" for Model code1, "14" for Model code2.

7.4 MODBUS (RTU) Communication

7.4.1 Overview of MODBUS (RTU)

◆8-bit binary data in command is transmitted as it is.

Data format	Start bit	: 1 bit
	Data bit	: 8 bits *7bits is not available.
	Parity	: No parity, Even parity, Odd parity Selectable
	Stop bit	: 1 bit (Fixed)
	Error detection	: CRC-16 (Cyclic Redundancy Check)
	Data interval	: 3.5 character transmission time or less

◆Message configuration

RTU mode is configured to start after idle time processing of more than 3.5 character transmissions and end after idle time processing of more than 3.5 character transmissions.

3.5 idle characters	Slave address	Function code	Data	Error check CRC-16	3.5 idle characters
	8-bit	8-bit	＊＊bits	16-bit	

Master judges the transmission complete after no command for 4-characters idle time and process the command.

*Transmission speed and judgment time to complete transmission

Transmission speed (bps)	Judgment time to complete (ms)
38400	about 1.00
19200	about 2.00
9600	about 4.00
4800	about 8.00
2400	about 16.00

◇Slave address:

Slave address is an individual instrument number on the slave side and is set within the range 1 to 99 (01H to 63H). Master identifies slaves by the slave address of the requested message.

Slave informs master which slave is responding to master by placing its own address in the response message. Slave address 0 (00H, broadcast address) can identify all slaves connected. However slaves do not respond.

◇Function code: Function code is command code for the slave to undertake the following action types.

Function code	Contents
03(03H)	DT Read
06(06H)	DT1 word write
16(10H)	DT several data write

Function code is used to discern whether the response is normal (acknowledgement) or if any error (negative acknowledgement) has occurred when slave returns response message to master.

When acknowledgement is returned, slave simply returns original function code. When negative acknowledgement is returned, MSB of original function code is set as 1 for response.

For example, when the master sends request message setting 00H to function code by mistake, slave returns 80H by setting MSB to 1, because the former is an illegal function.

For negative acknowledgement, the exception codes below are set to data of response message and returned to master in order to inform it of what kind of error has occurred.

Exception code	Contents
1(01H)	Illegal Function (Non-existent function)
3(03H)	Illegal data value (Value out of the devise numbers)

note1) Even if it commands to write (06H.10H) to non-existent data address, slave response with acknowledgement. However, it doesn't write.

note2) Even if it commands to write the value out of the setting range, slave response with acknowledgement. However, it doesn't write.

note3) The maximum number of reading slaves is 26 (57 bytes), the maximum number of writing slaves is 23 (55 bytes).

◇Data: Data depends on the function code.
A request message from the master side is composed of data item, number of data and setting data.
A response message from the slave side is composed of number of bytes, data and exception code in negative acknowledgement.
◇Error check: 16-bit data to detect communication errors. Refer to the next.
◇Acknowledgement response
When command is to write 1 point, same massage of command is responded.
When command is to write several points, part of command message (6 bytes) is responded.

◆Error check
After calculating CRC-16 (Cyclic Redundancy Check) from slave address to the end of data, the calculated 16-bit data is appended to the end of message in sequence from low order to high order.
<How to calculate CRC>
In CRC system, the information is divided by the polynomial series. The remainder is added to the end of the information and transmitted. The generation of polynomial series is as follows.
(Generation of polynomial series: $X^{16} + X^{15} + X^{2} + 1$)
1) Initialize the CRC-16 data (assumed as X) (FFFFH).
2) Calculate exclusive OR (XOR) with the 1st data and X. This is assumed as X.
3) Shift X one bit to the right. This is assumed as X.
4) When a carry is generated as a result of the shift, XOR is calculated by X of 3) and the fixed value (A001H). This is assumed as X. If a carry is not generated, go to step 5).
5) Repeat steps 3) and 4) until shifting 8 times.
6) XOR is calculated with the next data and X. This is assumed as X.
7) Repeat steps 3) to 5).
8) Repeat steps 3) to 5) up to the last data.
9) Set X as CRC-16 to the end of message in sequence from low order to high order.

◆Message example
<1> Reading electricity rate (0036H) of address 1
・Command

3.5 idle characters	Slave address (01H)	Function code (03H)	Data item (0036H)	Number of data (0001H)	Error check CRC-16 (6404H)	3.5 idle characters
	1	1	2	2	2	←character number

・Response message from slave in normal status (When Rate=1000(10.00) [03E8H])

3.5 idle characters	Slave address (01H)	Function code (03H)	Number of response byte (02H)	Number of data (03E8H)	Error check CRC-16 (B8FAH)	3.5 idle characters
	1	1	1	2	2	←character number

<2> Setting electricity rate (0036H) of address 1 (When rate is set to 20.00(2000) [07D0H])
・Command

3.5 idle characters	Slave address (01H)	Function code (06H)	Data item (0036H)	Number of data (07D0H)	Error check CRC-16 (6A68H)	3.5 idle characters
	1	1	2	2	2	←character number

・Response message from slave in normal status

3.5 idle characters	Slave address (01H)	Function code (06H)	Data item (0036H)	Number of data (07D0H)	Error check CRC-16 (6A68H)	3.5 idle characters
	1	1	2	2	2	←character number

<3> Reset integral electric power (0064H, 0065H: 2-word) of address 1

(When setting to 0 [0000, 0000H])

・Command

3.5 idle characters	Slave address (01H)	Function code (10H)	Data item (0064H)	Number of data item to write (0002H)	Number of data (04H)	⟹
	1	1	2	2	1	←character number

⟹	Date 1 (0000H)	Date 2 (0000H)	Error check CRC-16 (F474H)	3.5 idle characters
	2	2	2	←character number

・Response message from slave in normal status

3.5 idle characters	Slave address (01H)	Function code (10H)	Data item (0064H)	Number of data item to write (0002H)	Error check CRC-16 (0017H)	3.5 idle characters
	1	1	2	2	2	←character number

・A response message from the slave in exception (error) status

(When number of data has been mistaken.)

Function code MSB is set to 1 for the response message in exception (error) status (90H).
The exception code 03H (Value out of the devise numbers) is returned as contents of error.

<Mistaken message example (Command)>

3.5 idle characters	Slave address (01H)	Function code (10H)	Number of data item to write (0002H)	Number of data ***(06H)***	⟹
				↑ **Mistake**	

⟹	Data 1 (0000H)	Data 2 (0000H)	Error check CRC-16 (8DB4)	3.5 idle characters

<Response message from slave to mistaken command
(Response message in exception (error) status)>

3.5 idle characters	Slave address (01H)	Function code (90H)	Exception code (03H)	Error check CRC-16 (0C01H)	3.5 idle characters

7.4.2 Data Register List <AKW1111 (400VAC applicable type)>

Data item (MEWTOCOL)	Name	Unit	Kind of date	Range: Hexadecimal (Range: Decimal)	MODBUS Function code
0036H (DT00054)	Rate (CHG)	0.01	Unsigned 16bit	0H to 270FH (0 to 9999)	03H/06H/10H
0037H (DT00055)	Conversion factor (CO_2)	0.001 kg-CO^2	Unsigned 16bit	0H to 270FH (0 to 9999)	03H/06H/10H
003CH (DT00060)	CT type	Rated A (rms)	Unsigned 16bit	5H(5),32H(50),64H(100), FAH(250),190H(400), 258H(600)	03H/06H/10H
003DH (DT00061) 003EH (DT00062)	Unit for Pulse output	—	Unsigned 32bit	1H(1)<0.001>, AH(10)<0.01>, 64H(100)<0.1>, 3E8H(1000)<1>, 2710H(10000)<10>, 186A0H(100000)<100>, 3E7H(999) <Instantaneous electric power: Values of 0040H,0041H> 309H(777) <Ratio for current alarm: Values of 0045H> 22B(555) <Preset value for output: Values of 009EH,009FH> 14DH(333) <Ratio and time for stand-by alarm: Values of 004DH,00E4H>	03H/06H/10H
003FH (DT00063)	Primary side current value when CT 5A	1A	Unsigned 16bit	1H to FA0H (1 to 4000)	03H/06H/10H
0040H (DT00064) 0041H (DT00065)	Power alarm value (Instantaneous active power)	0.01kW	Unsigned 32bit	0H to F423FH (0 to 999999)	03H/06H/10H
0042H (DT00066)	VT ratio	0.01	Unsigned 16bit	64H to 270FH (100 to 9999)	03H/06H/10H
0043H (CT00067)	Current threshold for time measurement	0.1%	Unsigned 16bit	1H to 3E8H (1 to 1000)	03H/06H/10H
0044H (DT00068)	Cutoff current	0.1%	Unsigned 16bit	AH to 1F4H (10 to 500)	03H/06H/10H
0045H (DT00069)	Current alarm value	0.1%	Unsigned 16bit	AH to 3E8H (10 to 1000)	03H/06H/10H
0046H (DT00070)	Voltage range	—	Unsigned 16bit	1H(1):400V 2H(2):200V	03H/06H/10H
004DH (DT00077)	Current ratio for stand-by alarm	0.1%	Unsigned 16bit	AH to 3E8H (10～1000)	03H/06H/10H
004EH (DT00078)	Time for stand-by Alarm	—	Unsigned 16bit	1H to 270FH (1～9999)	03H/06H/10H
0064H (DT00100) 0065H (DT00101)	Integral electric Power	0.01kWh	Unsigned 32bit	0H to 3B9AC9FFH (0 to 999999999)	03H/06H/10H
006BH (DT00107)	R-current	0.1A	Unsigned 16bit	0H to EA60H (0 to 60000)	03H
006CH (DT00108)	S-current	0.1A	Unsigned 16bit	0H to EA60H (0 to 60000)	03H
006DH (DT00109)	T-current	0.1A	Unsigned 16bit	0H to EA60H(0 to 60000)	03H
006FH (DT00111)	Power factor	0.01	Signed 16bit	FF9DH to 0064H (-99 to 100)	03H
0070H (DT00112)	Frequency	0.1Hz	Unsigned 16bit	0H to 3E8H (0 to 1000)	03H

Data item (MEWTOCOL)	Name	Unit	Kind of date	Range: Hexadecimal (Range: Decimal)	MODBUS Function code
0096H (DT00150)	Load ON-time	0.1h	Unsigned 16bit	0H to F423FH (0 to 999999)	03H/06H/10H
0097H (DT00151)					
0098H (DT00152)	Load OFF-time	0.1h	Unsigned 16bit	0H to F423FH (0 to 999999)	03H/06H/10H
0099H (DT00153)					
009AH (DT00154)	Pulse count value	－	Unsigned 32bit	0H to F423FH (0 to 999999)	03H/06H/10H
009BH (DT00155)					
009EH (DT00158)	Preset value	－	Unsigned 32bit	0H to F423FH (0 to 999999)	03H/06H/10H
009FH (DT00159)					
00A0H (DT00160)	Prescale value	－	Unsigned 32bit	0H to 186A0H (0 to 100000)	03H/06H/10H
00A1H (DT00161)					
00A2H (DT00162)	Max. counting speed	Hz	Unsigned 16bit	1EH (30), 7D0H (2000)	03H/06H/10H
00A3H (DT00163)	Auto-off time	min	Unsigned 16bit	0H to 63H (0 to 99) (0H:always on)	03H/06H/10H
00AAH (DT00170)	R(RS)-voltage	0.1V	Unsigned 32bit	0H to F423FH (0 to 999999)	03H
00ABH (DT00171)					
00ACH (DT00172)	S(RT)-voltage	0.1V	Unsigned 32bit	0H to F423FH (0 to 999999)	03H
00ADH (DT00173)					
00AEH (DT00174)	T(TS)-voltage	0.1V	Unsigned 32bit	0H to F423FH (0 to 999999)	03H
00AFH (DT00175)					
00B0H (DT00176)	Instantaneous electric power	0.01kW	Unsigned 32bit	0H to F423FH (0 to 999999)	03H
00B1H (DT00177)					

7.4.3 Data Register List <AKW1110>

Data item (MEWTOCOL)	Name	Unit	Kind of date	Range: Hexadecimal (Range: Decimal)	MODBUS Function code
0036H (DT00054)	Rate (CHG)	0.01	Unsigned 16bit	0H to 270FH (0 to 9999)	03H/06H/10H
0037H (DT00055)	Conversion factor (CO_2)	0.001 kg-CO^2	Unsigned 16bit	0H to 270FH (0 to 9999)	03H/06H/10H
003CH (DT00060)	CT type	Rated A (rms)	Unsigned 16bit	5H(5),32H(50),64H(100), FAH(250),190H(400), 258H(600)	03H/06H/10H
003DH (DT00061) 003EH (DT00062)	Unit for Pulse output	—	Unsigned 32bit	1H(1)<0.001>, AH(10)<0.01>, 64H(100)<0.1>, 3E8H(1000)<1>, 2710H(10000)<10>, 186A0H(100000)<100>, 3E7H(999) <Instantaneous electric power: Values of 0040H,0041H> 309H(777) <Ratio for current alarm: Values of 0045H>	03H/06H/10H
003FH (DT00063)	Primary side current value when CT 5A	1A	Unsigned 16bit	1H to FA0H (1 to 4000)	03H/06H/10H
0040H (DT00064) 0041H (DT00065)	Power alarm value (Instantaneous active power)	0.01kW	Unsigned 32bit	0H to F423FH (0 to 999999)	03H/06H/10H
0042H (DT00066)	VT ratio	0.01	Unsigned 16bit	64H to 270FH (100 to 9999)	03H/06H/10H
0043H (CT00067)	Current threshold for time measurement	0.1%	Unsigned 16bit	1H to 3E8H (1 to 1000)	03H/06H/10H
0044H (DT00068)	Cutoff current	0.1%	Unsigned 16bit	AH to 1F4H (10 to 500)	03H/06H/10H
0045H (DT00069)	Current alarm value	0.1%	Unsigned 16bit	AH to 3E8H (10 to 1000)	03H/06H/10H
0064H (DT00100) 0065H (DT00101)	Integral electric Power	0.01kWh	Unsigned 32bit	0H to 3B9AC9FFH (0 to 999999999)	03H/06H/10H
006BH (DT00107)	R-current	0.1A	Unsigned 16bit	0H to EA60H (0 to 60000)	03H
006DH (DT00109)	T-current	0.1A	Unsigned 16bit	0H to EA60H (0 to 60000)	03H
0096H (DT00150) 0097H (DT00151)	Load ON-time	0.1h	Unsigned 32bit	0H to F423FH (0 to 999999)	03H/06H/10H
0098H (DT00152) 0099H (DT00153)	Load OFF-time	0.1h	Unsigned 32bit	0H to F423FH (0 to 999999)	03H/06H/10H
00A3H (DT00163)	Auto-off time	min	Unsigned 16bit	0H to 63H (0 to 99) (0H:always on)	03H/06H/10H
00AAH (DT00170) 00ABH (DT00171)	R(RS)-voltage	0.1V	Unsigned 32bit	0H to F423FH (0 to 999999)	03H
00AEH (DT00174) 00AFH (DT00175)	T(TS)-voltage	0.1V	Unsigned 32bit	0H to F423FH (0 to 999999)	03H
00B0H (DT00176) 00B1H (DT00177)	Instantaneous electric power	0.01kW	Unsigned 32bit	0H to F423FH (0 to 999999)	03H

Chapter 8 Specifications

8.1 Main unit

Item	AKW1111	AKW1110
Rated operating voltage	100-240V AC	
Rated frequency	50/60Hz common	
Rated power consumption	8VA (240VAC at 25℃)	6VA (240VAC at 25℃)
Inrush current	Max. 30A (240VAC at 25℃)	
Allowable operating voltage range	85-264V AC (85% to 110% of rated operating voltage)	
Allowable momentary power-off time	10ms	
Ambient temperature	-10 to +50℃ (-25℃ to +70℃ at storage)	
Ambient humidity	30 to 85%RH (at 20℃) non-condensing	
Breakdown voltage(initial)	Between the isolated circuits: 2000V for 1min	A)Outer edge (enclosure)－All terminals B)Between Insulated circuit ・Operating power supply terminals－Analog input terminals ・RS485－All other terminals ・Pulse output terminals－All other terminals
Insulation resistance(initial)	Between the isolated circuits: 100MΩor more (measured at 500V DC)	
Vibration resistance	10 to 55Hz (1cycle/min) single amplitude : 0.375mm(1h on 3 axes)	
Shock resistance	Min. 294m/s^2 (5 times on 3 axes)	
Display method	LCD with backlight Upper: Green Lower: Amber	4-digit, 16-segment, letters H: 6.5mm 6-digit, 7-segment, letters H: 7.5mm
Power failure memory method	EEP-ROM (more than 100,000 overwrite)	Memory items: Setting value Measuring value
Size	75 x 90 x 50 mm	
Weight	approx.170g	

note1) Analog input terminals: No.4, No.5 and No. 6
No.7, No.13 and No.14 terminals are connected to analog input circuit internal.

8.2 Input Specifications

8.2.1 Electric power input

Item		AKW1111	AKW1110
Phase and wire system		Single-phase two-wire system Single-phase three-wire system Three-phase three-wire system Three-phase four-wire system (common)	Single-phase two-wire system Single-phase three-wire system Three-phase three-wire system (common)
Input voltage	Rating	1P2W : 0-440V AC (Line voltage) 1P3W : 0-220V AC (Phase voltage) 3P3W : 0-440V AC (Line voltage) 3P4W : 0-254V AC (Phase voltage)	1P2W : 0-220V AC (Line voltage) 1P3W : 0-110V AC (Phase voltage) 3P3W : 0-220V AC (Line voltage)
	Allowable measurement voltage	Up to 120% of rated input voltage 1P2W : 0-528V AC (Line voltage) 1P3W : 0-264V AC (Phase voltage) 3P3W : 0-528V AC (Line voltage) 3P4W : 0-300V AC (Phase voltage)	1P2W : 0-264V AC (Line voltage) 1P3W : 0-132V AC (Phase voltage) 3P3W : 0-264V AC (Line voltage)
	VT ratio	1.00 to 99.99 (Set with setting mode) ***Voltage transformer (VT) is required when you measure a load with voltage over the allowable measurement voltage.** ***Secondary voltage rating of VT is 110V.**	

Input current	Primary side rating	<Using the dedicated CT> ・5A/50A/100A/250A/400A/600A (Select with setting mode) <Using a commercial CT with the secondary side current 5A> ・1 to 4000A (Set with setting mode) ***Use a CT with secondary side current of 5A when measure 600A or more.**
Special functions	Cut-off current	1.0 to 50.0%F.S (Set with setting mode)
	Cut-off voltage	Below 5% of rating voltage (Rating voltage x 0.05 x VT ratio) (Fixed)
	Current threshold for hour meter	1.0 to 100.0%F.S.
Accuracy (without error in CT and VT)	Indication accuracy	Instantaneous electric power / Integral electric power / Electricity charge / Conversion value
		Within ± (2.0 % F.S. + 1 digit) (at 20 °C, rated input, rated frequency, power factor 1) In case of 5 A CT mode, within ± (2.5 % F.S. + 1 digit) ***Accuracy coverage:5 to 100% of rated current**
		Current
		Within ± (1.0 % F.S. + 1 digit) In case of 5 A CT mode, within ± (2.5 % F.S. + 1 digit) (at 20 °C rated input, rated frequency, power factor 1) ***Accuracy coverage: 5 to 100 % of rated current**
		Voltage
		Within ± (1.0 % F.S. + 1 digit) (at 20 °C rated input, rated frequency, power factor 1)
		Hour meter
		±(0.01%+1digit) (at 20℃) Monthly accuracy: ±260 sec.(for your reference) 〔In case power on start or current energizing ±(0.01%+1s+1 digit) (at 20℃)〕
	Temperature characteristics	Within ± (1.0 % F.S.+ 1 digit) In case of 5 A CT mode, within ± (1.5 % F.S. + 1 digit) (Range of -10 to 50 °C 14 to 122 °F, rated input, power factor 1)
	Frequency characteristics	Within ± (1.0 % F.S. + 1 digit) In case of 5 A CT mode, within ± (1.5 % F.S. + 1 digit) (Frequency change ± 5 % based on rated frequency, rated input, power factor 1)

8.2.2 Pulse input *only AKW1111 (400VAC applicable type)

Input mode		Addition (Fixed)
Max. counting speed		2kHz /30Hz (Select with setting mode)
Pulse input		Min. input signal width: 0.25ms (When 2kHz selected) /16.7ms (When 30Hz selected) ON:OFF ratio = 1 : 1
Input signal		Contact / No contact (open collector) ・Impedance when shorted: Max. 1kΩ ・Residual voltage when shorted: Max. 2V ・Impedance when open: Min. 100kΩ
Output mode		HOLD (Over count)
Prescale	Decimal point	under 3-digit
	Range	0.001 to 100.000 (Set with setting mode)

8.3 Output Specifications

8.3.1 Pulse output (Transistor output)

	AKW1111	AKW1110
Number of output point	1 point	
Insulation method	Optical coupler	
Output type	Open collector	
Output capacity	100mA 30V DC	
Pulse width	approx. 100ms	
ON state voltage drop	1.5V or less	
OFF state leakage current	100 μA or less	
Pulse output unit	0.001/0.01/0.1/1/10/100kWh/ Alarm(AL-P)/ Current alarm(AL-C)/ Stand-by alarm (AL-S) / Counter output (Cnt) (Selectable with setting mode)	0.001/0.01/0.1/1/10/100kWh/ Alarm(AL-P)/ Current alarm(AL-C) (Selectable with setting mode)

* We recommend the setting of minimum unit for pulse output for measurement shown as below.

Output pulse: 4 pulse or less per 1sec.

How to calculate

(Unit for pulse output: PL-P)＞(Max. measurement power [kW])／(3600[s]×4 [pulse/s])

Note (1) Improper unit setting may cause miss counting.
(2) If the OFF time is too short, there is a possibility of counting errors.

8.4 Communication Specifications

Interface		Conforming to RS485
Protocol		MEWTOCOL/MODBUS(RTU) (selectable with setting mode)
Isolation status		Isolated with the internal circuit
Number of connected units		99 (max.) *2 *3
Transmission distance		1200m (max.) *1
Transmission speed		38400/19200/9600/4800/2400bps (selectable with setting mode)
Transmission Format	Data length	8bit/7bit (selectable with setting mode) *4
	Parity	Not available / Odd number / Even number (selectable with setting mode)
	Stop bit	1bit (fixed)
Communication method		Half-duplex
Synchronous system		Synchronous communication method
Ending resistance		approx. 120Ω (built-in)

*1 Please check with the actual devices when some commercial devices with RS485 interface are connected. The number of connected devices, transmission distance, and transmission speed may be different according to using transmission line.

*2 For RS485 converter on the computer side, we recommend SI-35 and SI-35USB (from LINE EYE Co.,Ltd.).

*3 When using SI-35, SI-35USB or PLC from our company (which can be connected up to 99 units), up to 99 Eco-POWER METER can be connected. In case using this system with the other devices, up to 31 Eco-POWER METER can be connected.

*4 With MODBUS (RTU) protocol, it works only with 8bit.

8.5 Self-diagnostic function

If an error occurs, the following indication will be given.

Indicator	Meaning	Output status	To recover
Err0	CPU error	OFF	Turn the power off and then on again.
Err1	Memory error*		EEP-ROM life ended. Replace the unit.

*Includes the possibility that the EEP-ROM's life has expired.

8.6 Power Failure Memory

Eco-POWER METER memories integral electric power and working status to internal EEP-ROM until when power supply is off. (Power failure guarantee)

And every time to change each setting, each setting value is memorized to internal EEP-ROM at the same time. Therefore, change setting frequently makes EEP-ROM's life short. Avoid to usage like this.

*Especially be careful if you set by communication.

8.7 Applicable standard

Safety standard	EN61010-1		
EMC	EMI EN61326-1	Radiation interference field strength Noise terminal voltage	CISPR11 class A CISPR11 class A
	EMS EN61326-1	Static discharge immunity RF electromagnetic field immunity EFT/B immunity Surge immunity Conductivity noise immunity Power frequency magnetic field immunity Voltage dip / Instantaneous stop / Voltage fluctuation immunity	EN61000-4-2 EN61000-4-3 EN61000-4-4 EN61000-4-5 EN61000-4-6 EN61000-4-8 EN61000-4-11

8.8 Dedicated Current Transformer Specifications

●Clamp-on type

Model No		AKW4801C	AKW4802C	AKW4803C	AKW4804C	AKW4808C
Primary side rated current		5A / 50A	100A	250A	400A	600A
Secondary side rated Current		1.67mA / 16.7mA	33.3mA	125mA	200mA	
Transform ratio		3000:1	3000:1	2000:1	2000:1	3000:1
Ratio error		±2.0% F.S.				
Hole Dia (mm)		φ10	φ16	φ24	φ36	
Breakdown voltage (initial)		AC1000V/1min (Between through hole and output lead wire)		AC2000V/1min (Between through hole and output lead wire)		
Insulation resistance (initial)		Min. 100MΩ (at DC500V) (Between through hole and output lead wire)				
Vibration resistance	Functional	10 to 55Hz (1 cycle/ minute) single amplitude of 0.15mm (10 min. on X,Y and Z axes)				
	Destructive	10 to 55Hz (1 cycle/ minute) single amplitude of 0.375mm (1 hrs. on X,Y and Z axes)				
Shock resistance	Functional	Min. 98m/s^2 (4 times on X,Y and Z axes)				
	Destructive	Min. 294m/ s^2 (5 times on X,Y and Z axes)				
Output protection level		±7.5V with clamp element		±3.0V with clamp element		
Permissible clamping frequency		Approx. 100 times				
Ambient temperature		-10 to +50℃ (without frost and non-condensing)				
Storage temperature		-20 to +60℃ (without frost and non-condensing)				
Ambient humidity		30 to 85%RH (at 20℃) non-condensing				
Weight (with relay cable)		Approx. 60g	Approx. 90g	Approx. 200g	Approx. 295g	Approx. 450g

●Through type

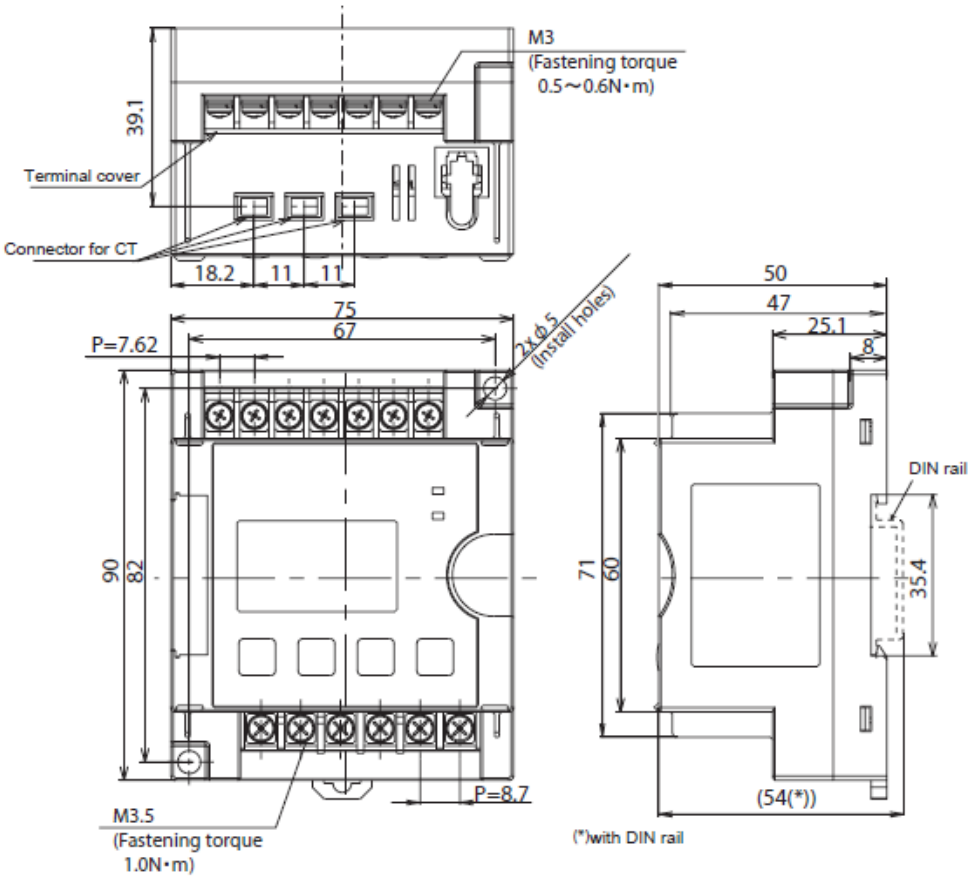
Model No		AKW4506C	AKW4507C	AKW4508C
Primary side rated current		50A / 100A	250A / 400A	600A
Secondary side rated Current		16.7mA / 33.3mA	125mA / 200mA	200mA
Transform ratio		3000:1	2000:1	3000:1
Ratio error		±1.0%F.S.		
Hole Dia (mm)		ϕ17	ϕ36	
Breakdown voltage (initial)		AC1000V/1min (Between through hole and output lead wire)	AC2000V/1min (Between through hole and output lead wire)	
Insulation resistance (initial)		Min. 100MΩ (at DC500V) (Between through hole and output lead wire)		
Vibration resistance	Functional	10 to 55Hz (1 cycle/ minute) single amplitude of 0.15mm (10 min. on X,Y and Z axes)		
	Destructive	10 to 55Hz (1 cycle/ minute) single amplitude of 0.375mm (1 hrs. on X,Y and Z axes)		
Shock resistance	Functional	Min. 98m/s^2 (4 times on X,Y and Z axes)		
	Destructive	Min. 294m/ s^2 (5 times on X,Y and Z axes)		
Output protection level		±7.5V with clamp element	±3.0V with clamp element	
Ambient temperature		-10 to +50℃ (without frost and non-condensing)		
Storage temperature		-20 to +60℃ (without frost and non-condensing)		
Ambient humidity		30 to 85%RH (at 20℃) non-condensing		
Weight (with relay cable)		Approx. 70g	Approx. 200g	Approx. 215g

Note) Dedicated current transformers (CT) are dedicated for low voltage under 440V. They can not be used for high voltage circuit. In case measuring high voltage circuit, make a 2-step construction by combination of a commercial CT of secondary side current 5A for high voltage and the dedicated CT for 5A.

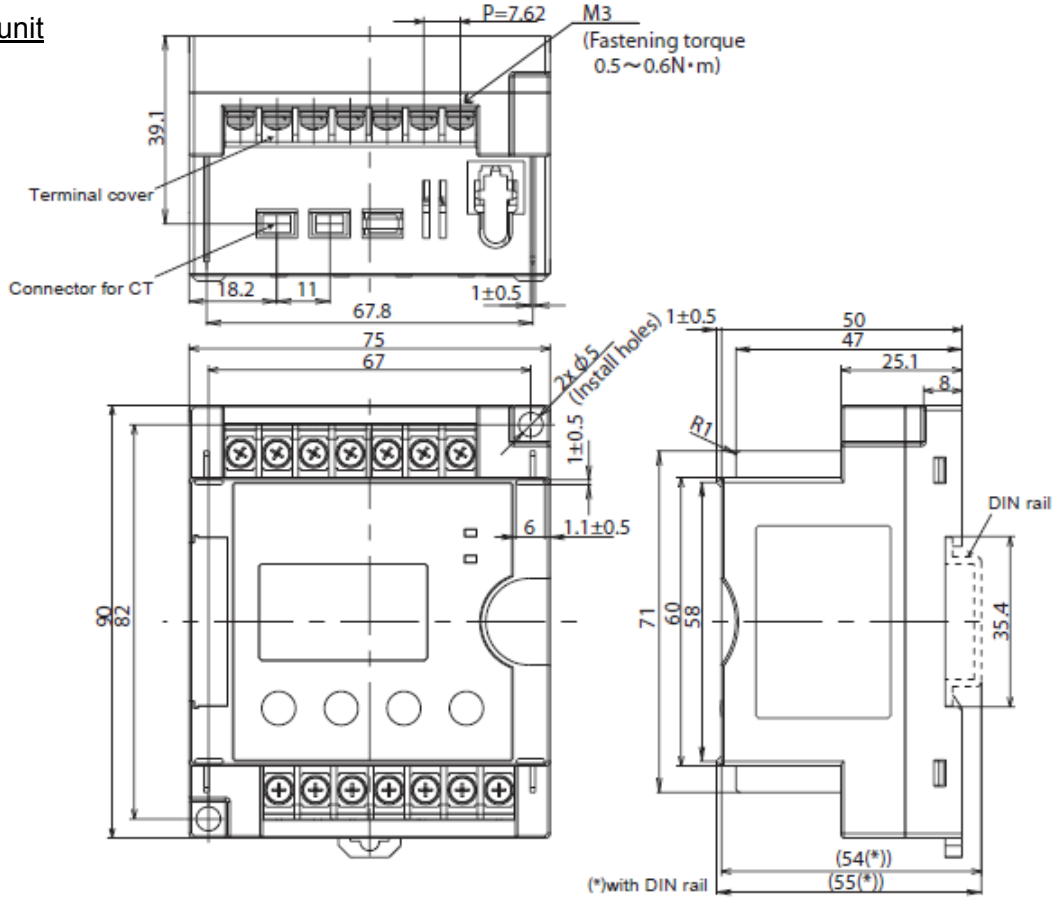
Chapter 9 Mounting

9.1 Dimensions

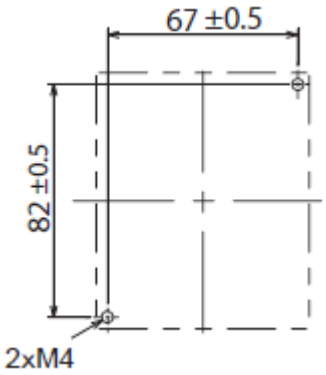
9.1.1 AKW1111 Main unit



9.1.2 AKW1110 Main unit



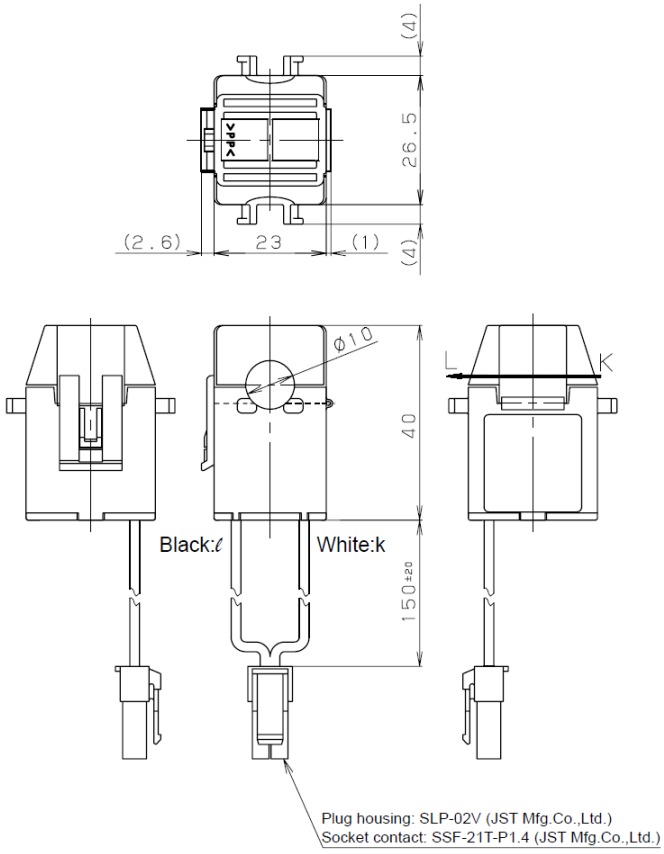
Panel cutout



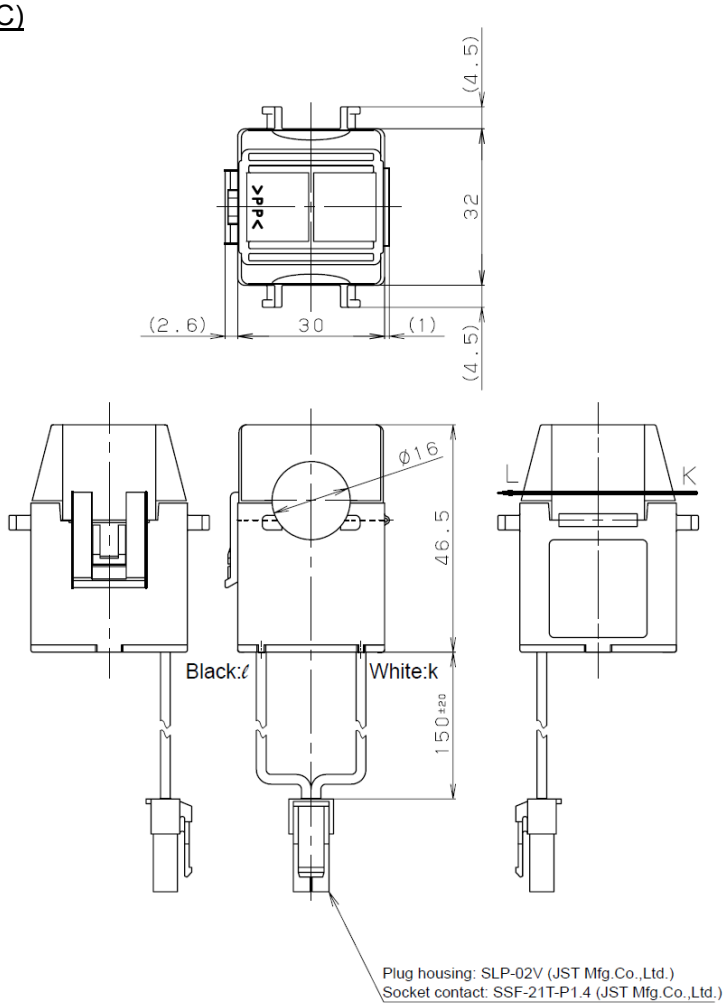
9.1.3 Dedicated CT

(unit: mm)
(tolerance: ±1.0)

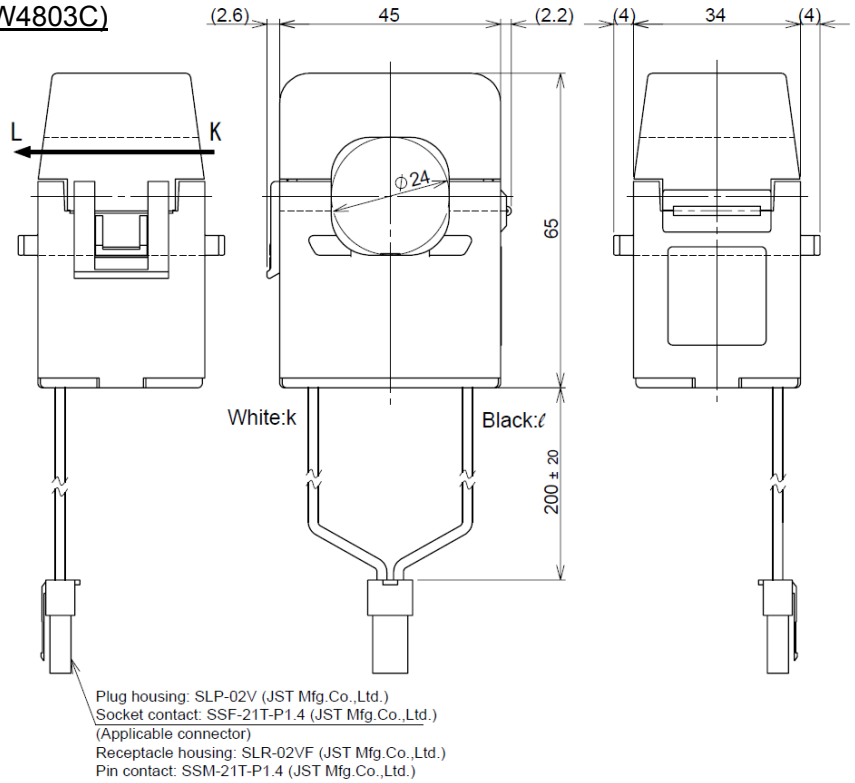
◆For 5A/50A (AKW4801C)



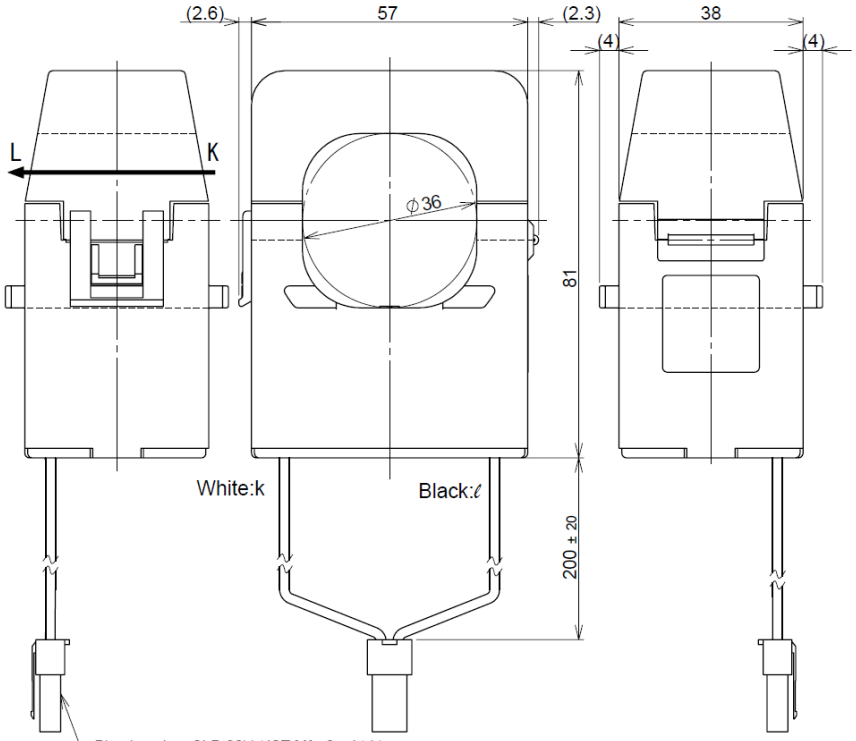
◆For 100A (AKW4802C)



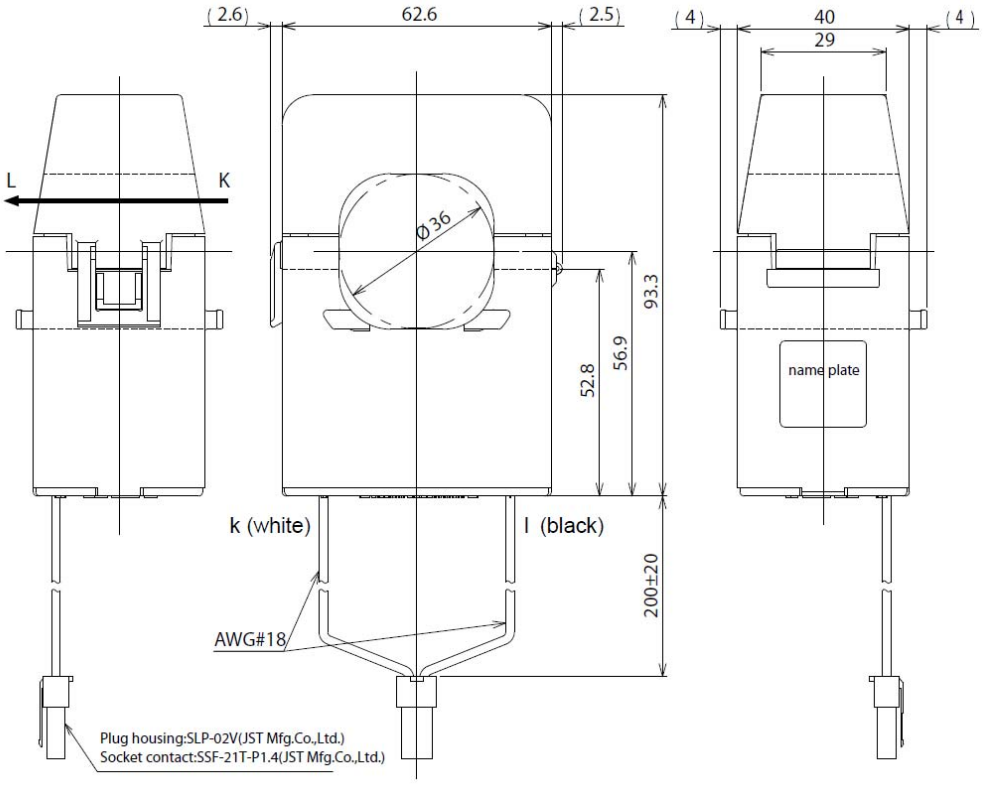
◆For 250A (AKW4803C)



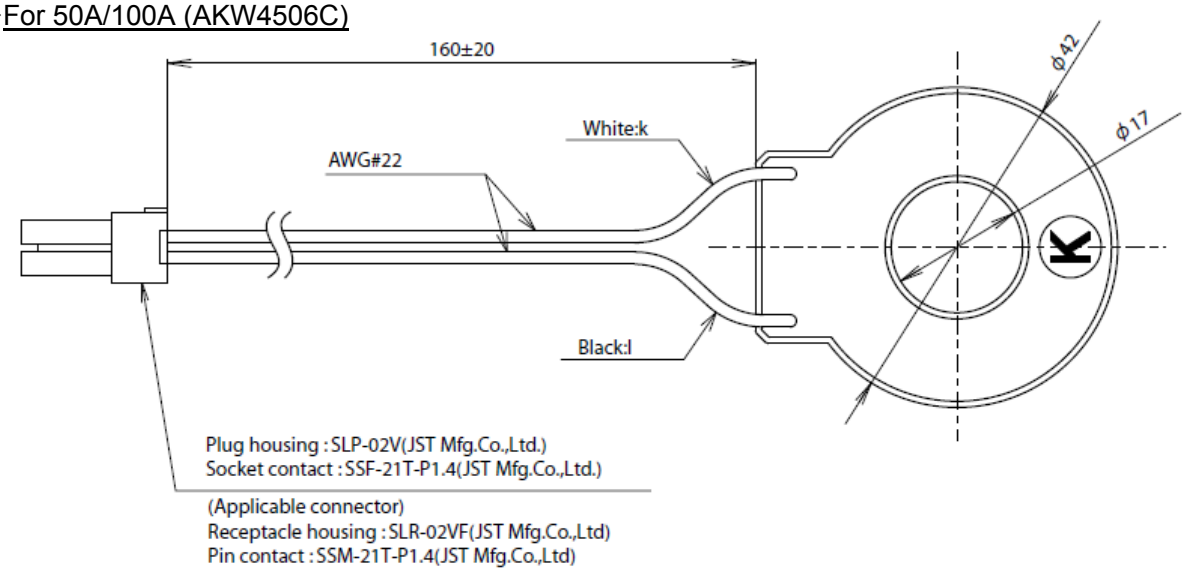
◆For 400A (AKW4804C)

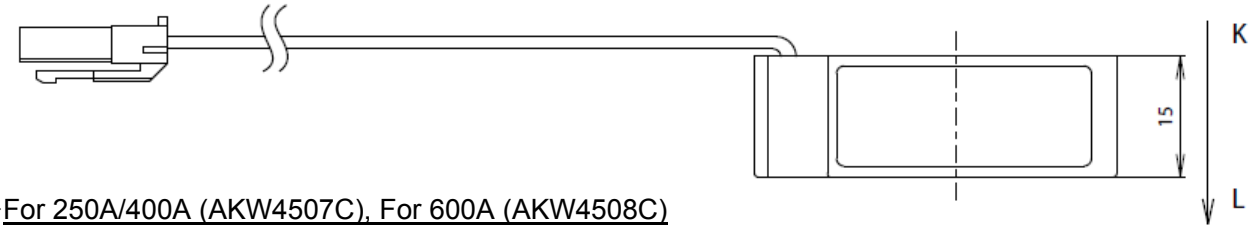


◆For 600A (AKW4808C)

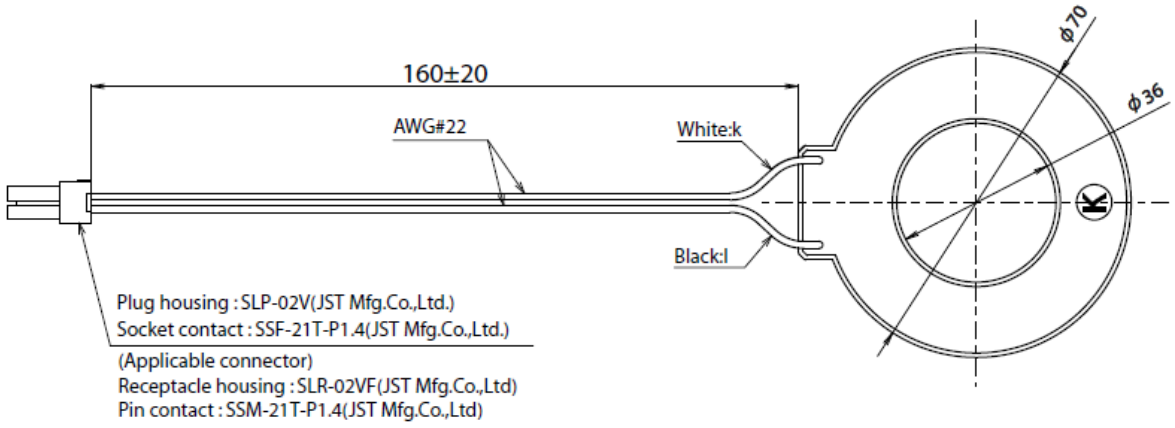


◆For 50A/100A (AKW4506C)

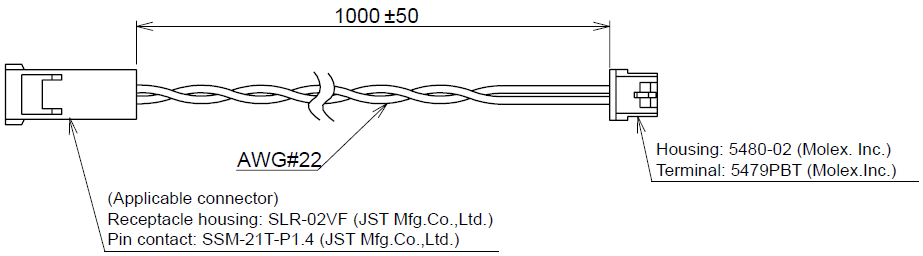




◆For 250A/400A (AKW4507C), For 600A (AKW4508C)

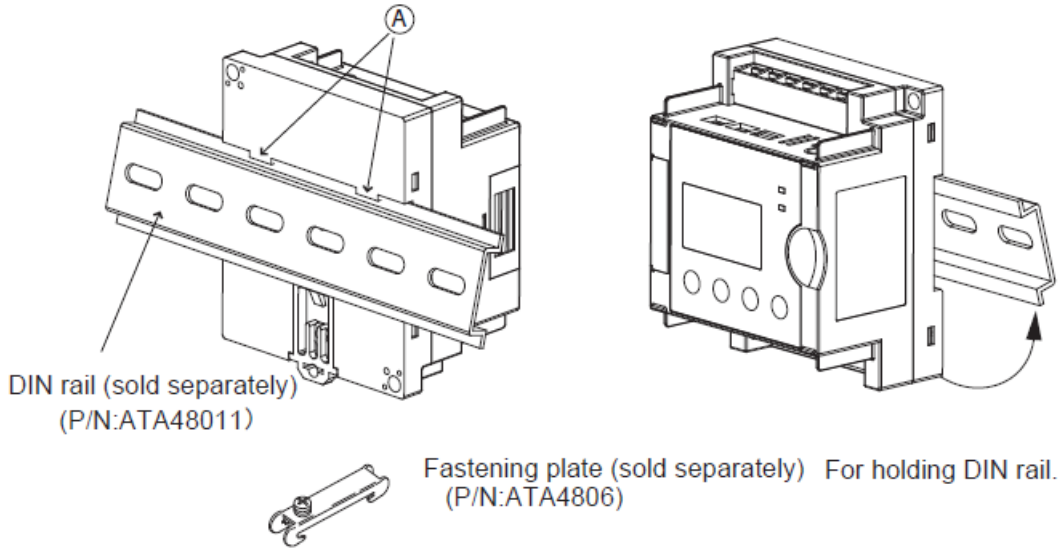


◆Attached trunk cable (common)



9.2 How to mount to DIN rail

(1) Hook “A” of main unit on the upper side of DIN rail.
(2) Making “A” part as a support fit the bottom side of main unit to DIN rail.
(3) It will be completely fixed to DIN rail with a “click” sound.



Chapter 10 Q&A

Q1	I'd like to measure by Eco-POWER METER. Measured load is 50 to 60A in normal operation. But the inrush current is 130 to 140 A. Which CT is selected? (100A or 250A)
A1	Select 100ACT. Stable current more than 1 second is necessary to measure. The inrush current seems to be a few ms, therefore it can't measure it. In case there is current over 1 second (inrush current), it measures it and select 250A CT.

Q2	Current and voltage are displayed. But it can't measure an electric power.
A2	・Do you install CT to the correct position and correct direction? CT has directions. Install CT according to the direction marked. From power supply side (K) to load side (L). ・Do you wire measurement voltage input correctly? When phases of voltage and current are not matched, it can't measure correctly. Please check the wiring.

Q3	How long do I extend CT cable?
A3	You can extend up to about 10 m with cable of AWG#22 or more. We can't guarantee the specifications if you extend more than 10m.

Q4	How do you guarantee the accuracy of measurement with low current range?
A4	Up to 10% for CT rating. In case of CT50A, for an electric power with current 5A or more, the accuracy is ±2.5%. (For PF=1)

Q5	How long do I extend pulse input cable?
A5	You can extend up to 10m with shielded wire or a metallic electric wire tube individually.

Q6	What do I use the function of primary side current of CT for?
A6	It is assumed that the use for 2nd stage CT with combination of CT. You set the primary side current of 1st stage CT (refer to mode1). In order to measure a large capacity current such as 1000A, it converts to 5A (small current) and measures the load.

Q7	Are there any attachments in order to fix CT?
A7	Sorry but there is no attachment.

Q8	Eco-POWER METER measures only voltage and current. How is it measure an electric power? What is the reason why it can't measure when CT is connected wrong direction?
A8	Electric power is calculated using instantaneous voltage and instantaneous current. When CT is connected wrong direction, it measures minus value in fact, but it displays 0kW with Eco-POWER METER.

Revision History

Issue Date	Manual no.	Content of revision
January, 2010	ARCT1F473E	First edition
January, 2012	ARCT1F473E-1	2nd edition [Add function] 600ACT input Add through type CT [Improve spec.] Improve the accuracy [Correct error] VT wiring
July, 2013	ARCT1F473E-2	3rd edition Company name change

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Specifications are subject to change without notice.

ARCT1F473E-2